2017 BASIN HIGHLIGHTS REPORT

AN OVERVIEW OF WATER QUALITY THROUGHOUT THE CANADIAN AND RED RIVER BASINS

Red River at US259

The preparation of this report was financed through and in cooperation with the Texas Commission on Environmental Quality

Big Blue Creek at FM 1913

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INTRODUCTION

In 1991, the Texas Legislature enacted the Texas Clean Rivers Act (Senate Bill 818) in order to assess water quality for each river basin in the state. From this, the Clean Rivers Program (CRP) was created and has become one of the most successful cooperative efforts between federal, state, and local agencies and the citizens of the State of Texas. It is implemented by the Texas Commission on Environmental Quality (TCEQ) through local partner agencies to achieve the CRP's primary goal of maintaining and improving the water quality in each river basin. The Red River Authority of Texas (Authority) is the partner agency for both the Canadian and Red River Basins.

A watershed management approach was selected as the best method to manage the state's diverse surface water resources. In order to achieve this, the Authority subdivided each basin into five reaches, or sub-watersheds, divided by natural hydrology and composed of classified and unclassified water bodies. The TCEQ identifies each of these classified segments in the *Texas Surface Water Quality Standards* (TSWQS). Water quality data resulting from the collection and analyses of water samples is used in the development of and compliance with these standards.

An integral part of the CRP is the Basin Highlights Report (BHR). This report is based on quality assured data as utilized in the *Texas Integrated Report (IR)*. The *IR* is an assessment of historical water quality data and is prepared by the TCEQ every two years, as required under the Federal Clean Water Act (CWA), Sections 305(b) and 303(d), as administered by the Environmental Protection Agency (EPA). The most recent, approved *2014 IR* may be accessed on the TCEQ's website at: **http://www.tceq.texas.gov/waterquality/assessment/14twqi/14txir**.

In 2014, the Authority produced the *2014 Basin Summary Report of the Canadian and Red River Basins (2014 BSR)*, which included extensive technical data analyses based on the *2012 Texas Integrated Report (2012 IR)*. This BHR utilizes information presented in the *Final 2014 IR*, which assessed surface water quality data collected between December 1, 2005 and November 30, 2012. This BHR discusses both classified segments and unclassified water bodies throughout the Canadian and Red River Basins, as well as any water quality impairments and/or concerns which may be present. It also includes discussions on various water quality related topics. Therefore, it is suggested that the reader view the *2014 BSR* for more in depth information. It may be found on the Authority's website at: **www.rra.texas.gov**.

Beaver Creek at FM 2326

Support Lake Wichita Sign

LAKE WICHITA REVITALIZATION PROJECT

BACKGROUND

In 1887 Joseph A. Kemp proposed a bond issue which would fund the construction of a dam and subsequent reservoir on Holliday Creek. However, bonds of this nature were prohibited by the Texas Constitution. After repeated lobbying failed, Mr. Kemp and a partner from Galveston were able to finance the project privately. $175,000 later, in 1901 Lake Wichita was completed, making it only the third man-made lake in Texas, preceded only by Lake Austin and Eagle Lake. Over one hundred years later, Lake Wichita is still a prominent feature in Wichita Falls, however, what was once termed the "Gem of North Texas" has faced its fair share of difficulties in the recent past.

Within the past decade, several fish kills resulting from golden alga blooms have accounted for the loss of approximately 250,000 fish (2004 - 7,700 fish, 2007 - 15,000 fish, 2009 - 200,000 fish, 2012 - unknown). While the golden alga blooms were effectively destroying the biota, the persistent drought that plagued much of the Canadian and Red River Basins from 2011 through 2015 took an unprecedented toll on Lake Wichita. By the end of the drought in May 2015, Lake Wichita had effectively been "dry" and without fish life for almost three (3) years. Even without the golden alga blooms, the concentration of pollutants, such as chloride, sulfate, total dissolved solids (TDS), temperature and depressed dissolved oxygen concentrations created an environment unsuitable to most aquatic life. These conditions ultimately led Lake Wichita to receive three (3) water quality impairments in the *2014 IR*.

ORIGIN

On May 7, 2013, the Wichita Falls City Council appointed members to the Lake Wichita Study Committee, tasked with developing goals and recommendations for recreation and non-recreation uses. On October 7, 2014 the name was changed to the Lake Wichita Revitalization Committee (LWRC) following the City Council's extension of the project for another eighteen (18) months.

GOALS

Excavation - With an average depth of only 4.5 feet, one hundred plus years of siltation have definitely taken its toll on Lake Wichita. The LWRC has plans to secure a 404 permit from the U.S. Army Corps of Engineers to dredge Lake Wichita.

Aquatic Habitat - Aquatic habitat and the quality/quantity of wildlife are directly correlated to one another. Following the excavation, the LWRC has plans to reintroduce several species of aquatic plants to reestablish aquatic habitats and prevent shoreline erosion.

Watershed - The drainage area surrounding Lake Wichita is home to non-native Mesquite and the highly invasive Salt Cedar. Both create issues with soil stability and erosion, which can lead to increased siltation. The LWRC hopes to work with land owners to remove these nuisances.

Recreation - The LWRC has plans to include camping, kayaking, fishing piers and much more to improve the recreational opportunities currently available at Lake Wichita.

WATER QUALITY ASSESSMENT OVERVIEW

When reading through the specific water body information presented over the next several pages of this year's report, please remember that this data is merely a snapshot of a water body, and that the overall health can and does vary tremendously over the course of weeks, months, years, and seasons. Equally important is to keep in mind that while two water bodies may receive the same rank, this does not mean that they have similar impairments or concerns. Rankings are solely based on the frequency of impairments (NS), concerns for screening level exceedances (CS), concerns for near non-attainment of water quality standard (CN), or a combination thereof.

RANK	NS	CS	CN	DESCRIPTION
	0	0	0	Water body has no impairments or concerns
	0	1	0	Water body has one concern for screening level exceedance
	0	0	1	Water body has one concern for near non-attainment of the water quality standard
	1	0	0	Water body has one impairment and no concerns
	0	>1	0	Water body has more than one concern for screening level exceedance
	0	0	>1	Water body has more than one concern for near non-attainment of the water quality standard
	0	1	1	Water body has one concern for both screening level exceedances and near non-attainment of the water quality standard
	>1	0	0	Water body has more than one impairment but no concerns
	1	≥1	0	Water body has a single impairment and concern(s) for screening level exceedances or concern(s) for near non-attainment of the water quality standard
	1	0	≥1	
	0	≥1	≥1	Water body has no impairments but more than one concern for both screening level exceedances and near non-attainment of the water quality standard
	≥1	≥1	≥1	Water body has one or more impairments and multiple concerns for both screening level exceedances and near non-attainment of the water quality standard
	>1	≥1	0	Water body has more than one impairment and multiple listings for either concerns for screening level exceedances or near non-attainment of the water quality standard
	>1	0	≥1	

Red River at SH 37

WHAT IS WATER QUALITY AND HOW IS IT EVALUATED?

Water quality is a combination of the physical, chemical, and biological characteristics of water. It is a measure of the condition of water relative to the requirements of one or more biotic species and/or to any human need or purpose. It is most frequently used as a comparator to a set of standards from which compliance can be monitored and assessed, the most common being those regulations governing the quality of drinking water.

Industrial and municipal dischargers must seek permission from the TCEQ prior to discharging any treated effluent into a surface water body. These entities are regulated through National Pollution Discharge Elimination System (NPDES) permits that set limits for various water quality parameters. Not all dischargers are similar; there are countless systems and treatment methods that vary depending on a number of different factors. This being said, the requirements and stringency of a NPDES permit also vary depending on such factors. When setting permitting requirements and limitations, it is also important to consider the use of the water body accepting the discharge. If, for example, a water body was classified as a drinking water source, the NPDES requirements would be much more stringent compared to a non-drinking water source.

The TCEQ evaluates the water quality of the state's water resources on a regular basis under provisions outlined in the CWA Sections 303(d) and 305(b). These results are compiled and published by the TCEQ through the IR. The *2014 IR* is the most current version and was approved by the EPA on November 19, 2015. Water bodies that do not meet the criteria determined by the TCEQ are identified with one of three classifications: impaired, having a concern for near non-attainment of standards, or concern for screening level violations. The following describes the classifications:

Impaired (NS)
Parameter has exceeded water quality standard set by the TCEQ. Once listed, this water body is scheduled for additional monitoring or a special study.

Concern for Near Non-Attainment of Standards (CN)
Parameter is close to exceeding the water quality standard set by the TCEQ. These sites require additional monitoring.

Concern for Screening Level Exceedance (CS)
Not all parameters have water quality standards, for example nutrients in streams. Instead, a narrative criteria exists. In cases where there is no segment-specific numeric criteria, the TCEQ developed screening levels based on the 85th percentile of nutrient values in the Surface Water Quality Monitoring Information System (SWQMIS) database. If a nutrient parameter exceeds this screening criteria more than 20% of the time, it is considered as having a CS.

PARAMETER	IMPACT	POTENTIAL CAUSE(S)
Ammonia	Naturally occurring in surface and wastewater, and is produced by the breakdown of compounds containing organic nitrogen. Elevated ammonia levels are a good indicator of organic pollution and can adversely affect fish and invertebrate reproductive capacity and reduced growth of the young.	Ammonia is excreted by animals and is produced during the decomposition of plants and animals. It is an ingredient in many fertilizers and is also present in sewage, storm water runoff, certain industrial wastewaters, and runoff from animal feedlots.
Alkalinity	A measure of the acid-neutralizing or buffering capacity of water. The presence of calcium carbonate ions to the buffering system. Alkalinity is a measure of how much acid can be added to a liquid without causing a large change in pH. Alkalinity is important for fish and aquatic life because it protects or buffers against rapid pH changes. Living organisms, especially aquatic life, function best in a pH range of 6.0 to 9.0.	Alkalinity is often related to hardness because the main source of alkalinity is usually the result from dissolved carbonate rock formation.
Chloride	One of the major inorganic ions in water and wastewater. Chloride is an essential element for maintaining normal physiological functions in all organisms. Elevated chloride concentrations can disrupt osmotic pressure, water balance, and acid/base balances in aquatic organisms which can adversely affect survival, growth, and/or reproduction.	Chloride compounds, often known as salts, can be an indicator of natural or manmade pollution, as in the case of oil field brines. Natural weathering and leaching of sedimentary rocks, soils, and salt deposits can release chloride in to the environment. Other sources can be attributed to oil exploration and storage, sewage and industrial discharges, runoff from dumps and landfills, and saltwater intrusion.
Chlorophyll-*a*	Increased nutrients in water bodies create diurnal swings that can stress aquatic life. In the presence of sunlight and abundant food sources photosynthesis increases, DO levels rise and pH levels fall. At night respiration begins and oxygen is consumed. DO levels fall and then pH levels rise.	Chlorophyll-*a*, is a photosynthetic pigment, that is found in all green plants and algae. The concentration of chlorophyll *a* is used to estimate phytoplankton biomass in surface water. Results are expressed in µg/L (micrograms per liter).
Conductivity	A measurement of the electrical current carrying capacity of water. Dissolved substances, such as salts, have the ability to conduct electrical current. Salty water has a high conductivity. This can be used as an indicator of how much dissolved solids are contained in the water.	Causes are basically the same as the causes for TDS.
Dissolved Oxygen (DO)	The amount of DO that is freely available in water. Aquatic life needs oxygen to live. DO is vital to fish and other aquatic life. DO levels have been accepted as the single most important indicator of a water body's ability to support desirable aquatic life.	Excessive or unusual quantities of organic material combined with bacteria and large algal blooms may cause DO levels to fluctuate. Large fluctuations in DO can create environmental conditions not suitable for aquatic life.
***Escherichia coli* (*E. coli*)**	The current indicator bacteria to determine if the water body is suitable for contact recreation. Potentially harmful to human health. Their presence, expressed in MPN (most probable number) per 100 mL of water, is an indicator of fecal matter contamination which may contain other pathogens.	Elevated concentrations of *E. coli* can indicate a potential pollution problem. Although *E. coli* is used as an indicator, it can be potentially harmful. *E. coli* is present in all warm bodied animals and comes from poorly maintained or ineffective septic systems, overflow of domestic wastewater plants and/or runoff from feedlots.
Enterococcus	A subgroup of fecal streptococci bacteria (mainly *Streptococcus faecalis* and *Streptococcusfaecium*) that is present in the intestinal tract of warm-blooded animals. It is used as an indicator of the potential presence of pathogens.	Elevated concentrations of *Enterococcus* indicate a potential pollution problem. Present in the intestine of all warm-blooded animals, *Enterococcus* is a good indicator of pollution coming from the same sources as *E. coli*.
Flow	The volume of water that moves over a designated point over a fixed period of time, often expressed in CFS (cubic feet per second). Flow, related with other parameters, can be a good indicator of water quality.	Changes in flow can be natural or man made. Natural changes include beavers building dams, overgrowth of vegetation in times of low flow. Man-made changes include new bridges restricting flow, new construction altering landscapes and runoff.

PARAMETER	IMPACT	POTENTIAL CAUSE(S)
Nitrates	Nitrate additions to surface waters can lead to excessive growth of aquatic plants. Elevated nitrate levels can be toxic to human health, especially in infants and young children. In elevated concentrations can be used as an indicator of human caused pollution.	Nitrates are used as fertilizers to supply a nitrogen source for plant growth. The presence of nitrates occurs from the conversion of nitrogenous matter into nitrates by bacteria and represents the process whereby ammonia in wastewater, is oxidized to nitrite and then to nitrate by bacterial or chemical reactions.
Nitrites	High levels of nitrates and nitrites can produce Nitrite Toxicity, or "brown blood disease," in fish. This disease reduces the ability of blood to transport oxygen throughout the body.	Nitrites are found in effluent released from wastewater treatment plants, fertilizers, and agricultural runoff carrying animal waste from farms and ranches.
pH	The pH determines whether a water body is acidic, neutral, or basic. The pH of the water can affect the toxicity of many substances. Most aquatic life is adapted to live within a specific pH range. Changes in the pH can control toxic effects of other substances that may be in runoff.	The pH of natural waters is typically between 6.5-9.0 standard units. Industrial and wastewater discharge, runoff, accidental spills, nonpoint sources and human activity that causes increases in organic matter and bacteria, and over abundant algae can alter the pH.
Sulfate	Usually dissolved into waters from rocks and soils containing gypsum, iron sulfides, and other sulfur compounds. Sulfides are widely distributed in nature and in high concentrations, sulfate can affect drinking water.	Due to abundance of elemental and organic sulfur; and sulfide mineral, soluble sulfate occurs in almost all natural water. Other sources are the burning of sulfur containing fossil fuels, steel mills, and fertilizers.
Temperature	The temperature of water at the time of collection. An important physical relationship exists between the amount of dissolved oxygen in a body of water and its temperature.	Changes in water temperature can be caused by alteration of the riparian zone encroachment of invasive species (plant and/or animal), drought, soil erosion, or changes in ambient temperatures in lakes, as a result of industrial byproducts such as electrical generation.
Total Dissolved Solids (TDS)	An important use of the measure of the quality of drinking water. TDS is a quantification of the material dissolved in water, typically the chloride, and sulfate anions which form salts.	TDS is present to some extent in all water bodies. However, primary sources of excess TDS include agricultural activities, storm water runoff, leaching of soil contamination, and point source water pollution from industrial or sewage treatment plants. Certain naturally occurring TDS arise from weathering and dissolution of rocks and soils.
Total Phosphorus	Total Phosphorus is the measure of all forms of phosphorus, dissolved and/or particulate. It is an essential nutrient to an organism's metabolism and therefore, can limit the primary productivity of a water body.	In excessive amounts from wastewater, agricultural drainage, and certain industrial wastes, it also contributes to the eutrophication of lakes and other water bodies. Phosphorus is commonly known as a man-made pollutant.
Total Suspended Solids (TSS)	Total Suspended Solids (TSS) is the measure of the total suspended solids in water (organic and inorganic). Increased turbidity can reduce the amount of light to plants, which decreases the oxygen production. Additionally, too much sediment can cover habitat, smother benthic organisms, eggs or even clog fish gills.	TSS can have origins from multiple point and nonpoint sources, but the most common source is soil erosion. A good measure of the upstream land use conditions is how much TSS rises after a heavy rainfall.
Turbidity	A measure of clarity of a water sample expressed in NTU's (Nephalometric Turbidity Units). The higher the turbidity, the less clear the water. Water that is turbid can adversely affect plant and fish populations .	Erosion of soil in the riparian zone, point source water pollution from industrial or sewage treatment plants, and stormwater runoff can adversely affect turbidity.


Dundee State Fish Hatchery

Dundee State Fish Hatchery

Back In Business

The Dundee State Fish Hatchery is located approximately 30 miles Southwest of Wichita Falls, Texas and just North of the small town of Dundee, just below the dam of Lake Diversion. Built in 1927, it originally contained 44 fish ponds (32.9 surface acre of water) and several buildings. Several expansion projects have since taken place, making Dundee currently the largest Texas state fish hatchery in operation. This multi-million fish producing operation came to halt in 2012 when Lake Kemp reached dangerously low water levels due to extreme drought conditions. For the first time since the hatchery opened in 1927, several years of drought in the area caused the Dundee hatchery to shut down. Without water being supplied to the fish ponds, all operations of fish propagation had to be moved elsewhere in the state to meet the demands of freshwater angling.

Background

As history shows, droughts come and go in the State of Texas. But perhaps the most recent one, which began in 2010, has put the citizens of Texas on notice for knowing how precious water can be to the area. Many businesses throughout the Canadian and Red River Basins felt how brutal a Texas drought can be. Agricultural conditions in both basins suffered with many ranchers across North Texas having to take desperate measures to get through to the next day, such as the selling off livestock. A drive out to many of the area lakes probably painted the best picture in one's mind on how devastating the drought was. Many officials in the area were coming up with fantastic ideas to help curve the impact of the drought that took place on the daily lives of many. All of the state's fish hatcheries operate on water rights that can be cut off during a priority call. The City of Wichita Falls and the Wichita County Water Improvement District No. 2 own the water rights to Lake Kemp that feeds water to Lake Diversion where the Dundee hatchery operates. With both entities trying preserve its drinking water resources, the hatchery and its employees ultimately suffered.

Operation

The Dundee facility is one of five freshwater hatcheries across the state and produces mostly Striped Bass, Hybrid Striped Bass, Channel Catfish, Rainbow Trout, Walleye and Koi Carp. There were substantial renovation projects in 1986 and 1993 that included seventy-three new ponds with state-of-the-art polypropylene membrane liners at a cost of 7 million dollars. The expansion projects made over the years expanded the operation to ninety-seven ponds, that provide 83 surface acres of water, which is approximately 32 percent of the production space in all five state operated hatcheries in Texas. Before the drought starting taking its toll on the area in 2010, the Dundee facility could produce about 3.1 million fingerlings a year, which accounted for about 22 percent of all fingerlings produced by state hatcheries in Texas. The hybrid and stripers produced at the Dundee facility are stocked in reservoirs across the state, while the catfish end up in state parks and community fishing lakes. Catfish are reared at the Dundee facility throughout the summer until they grow to the targeted size.

Dundee State Fish Hatchery

Here Comes the Rain

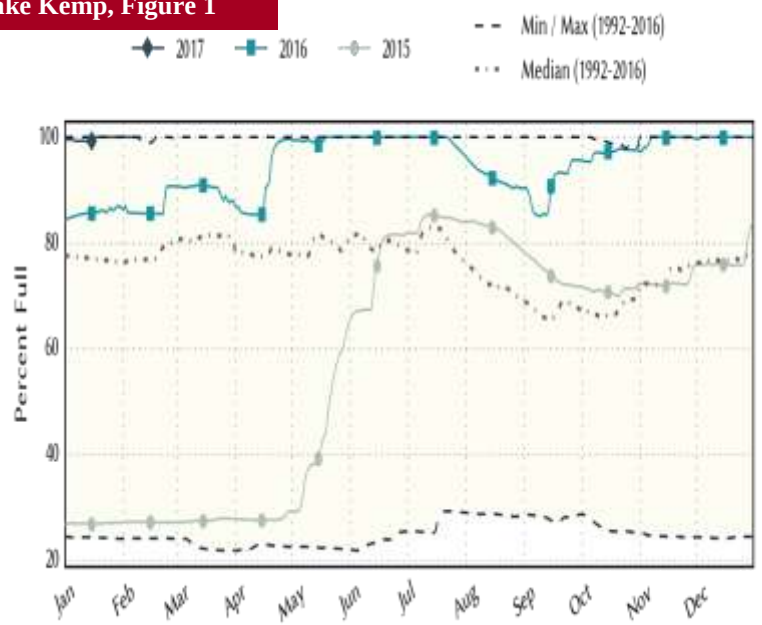
May 2015 turned out be the wettest May in record for the area, compiling 17.0 inches of total rain for the month. As a result, many of the area streams and rivers saw record breaking run-off which caused Lake Diversion to flow over its spillway. Lake Kemp didn't receive as much water as the other area lakes, but it finally reached 100 percent in May 2016 for the first time in five years.

The drought had left Lake Kemp water supply to a low of 22 percent capacity, see Figure-1. In the Spring of 2016, the water levels finally allowed the Dundee State Fish Hatchery to open its doors for operation with limited production after a long four year hiatus. It will take several years to get the hatchery back up to full production. During the process of re-starting the hatchery, many situations come into play, such as maintenance and personnel requirements. In the meantime of the start-up process, the TPWD has engineers looking at the possibility of water re-use and o-zone disinfectant units installed at the Dundee facility to help the hatchery continue operation during times of drought.

Conclusion

Having the Dundee facility open again is good news for the people it employs and anglers of the State of Texas. State operated hatcheries play a vital role in the fishing industry in Texas. Hatcheries provide different avenues to help sustain fish populations and aid in research efforts for different species. Also, many hatcheries provide the opportunity for families to get out and enjoy the outdoors through fishing by providing urban fishing reservoirs with plenty of fish where natural production could not meet the demand of anglers. The Dundee hatchery is a big part of the Inland Fish Hatchery Program of the TPWD and provides many benefits for the public.

Lake Kemp, Figure 1



Lake Diversion Spillway

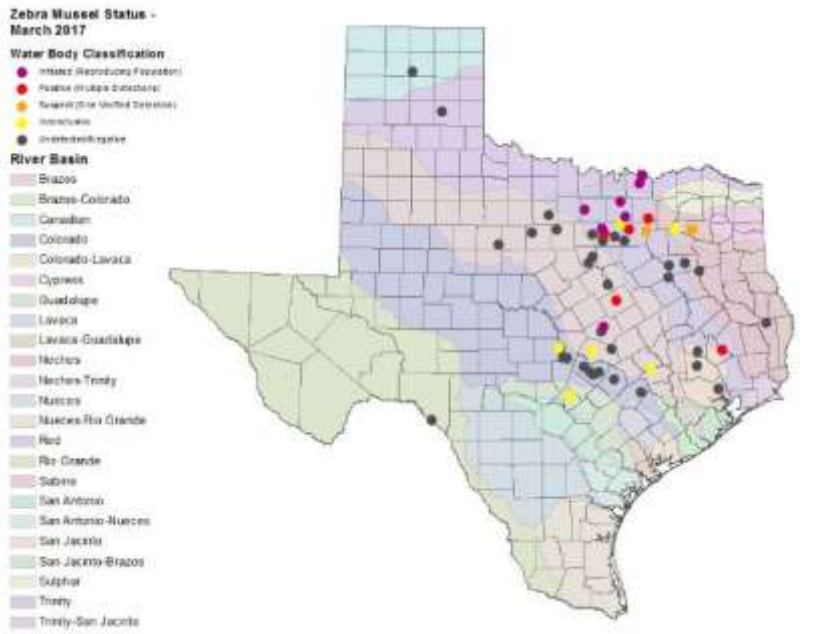
ZEBRA MUSSELS – WHERE ARE THEY NOW?

Origin

Native to Russia, the zebra mussel (*Dreissena polymorpha*) were first introduced into North American waters as seemingly innocent hitchhikers in the ballasts of ships entering Lake St. Clair, Michigan in the late 1980's. Once established, the species quickly spread throughout the Great Lakes, eventually infiltrating some thirty (30) states and more than 600 lakes and reservoirs to date, according to recent data from the United States Geological Survey (USGS). In the beginning it was thought that southern waters were too warm for the zebra mussel to survive and reproduce, but this highly adaptive species has found a way.

Current Texas Populations

Zebra mussels grow to a maximum diameter of around two inches and are identified by their triangular shape. Although they commonly have a stripe-like pattern, they can be solid white to dark brown in color. Due to their filtration eating habits, they can easily out-compete native algae and other aquatic plants by rapidly depleting any and all available nutrients within the water column. In turn, native species of fish and other aquatic life, which would have fed on this aquatic vegetation, are out-competed. Zebra mussels can spawn in water temperatures above 54°F and can produce over one million eggs in a spawning season. Their colonization traits make the zebra mussel highly destructive to water lines and pipes. They are notorious for colonizing in public and private water structures and piping, which can disrupt or even stop the flow of water.



Courtesy Texas Parks and Wildlife Department

Impact

Zebra mussels may have a rather innocent appearance, but established populations are anything but. Despite out-competing native aquatic vegetation and fish species, zebra mussels negatively affect recreational activities and public and private properties. Boats, piers, buoys, and practically anything with a hard substrate left in a zebra mussel infested water body is a prime spot for them to colonize. Zebra mussels have been seen inside boat engines and cooling systems, clogging lines and causing engines to malfunction. Once encrusted on the bottom of a boat or other recreational water craft, their removal can be expensive, if even possible.

Control Measures

To control the spread of this highly invasive species, the Texas Legislature has created multiple control measures through the TPWD, where they have focused on public outreach programs and publications to help prevent the transportation of the zebra mussel to other water bodies. For more information on zebra mussels and what you can do to help prevent the spread please visit: **http://www.texasinvasives.org/zebramussels/.**


Canadian River at US 83

CANADIAN RIVER BASIN

REACH I (Refer to map on page 34)

Canadian River Below Lake Meredith (Segment 0101) 💧
Stations 10032, 10033, 10035, 20702
The Canadian River Below Lake Meredith has concerns for screening level exceedances for ammonia and chlorophyll-*a*, as well as a concern for the near non-attainment for depressed dissolved oxygen. It also maintained a single impairment for bacteria first listed in the *2012 IR*. It is likely that the elevated levels of chlorophyll-*a* continue to be playing a role in the depressed dissolved oxygen values being observed during routine monitoring.

Dixon Creek (Segment 0101A) 💧
Stations 10016, 17045
This unclassified water body appears in the *2014 IR* with bacteria, depressed dissolved oxygen, and selenium in water impairments. Additionally, there are concerns for both chlorophyll-*a* and nitrate. Until recently, Dixon Creek has been plagued with little to no flow and pools of shallow water due to the drought conditions witnessed in the Canadian River Basin. The area ranges drastically from underdeveloped to moderately developed with both agricultural and industrial uses. Increased nutrient input from the surrounding land is most likely the cause for the elevated nutrient and bacteria levels, which could be the reasoning behind the low dissolved oxygen levels observed during routine monitoring. With increased rainfall returning to the area in the summer of 2015, the Authority will have the opportunity to deploy field instruments to conduct 24-hour dissolved oxygen studies which will provide much needed data to help determine the potential causes of the low dissolved oxygen levels being captured within the segment.

Rock Creek (Segment 0101B) 💧💧💧
Station 10024
Rock Creek remains impairment-free after bacteria was removed in the *2012 IR*. However, it does remain listed for nitrate, total phosphorus, and chlorophyll-*a* concerns. This segment is primarily effluent dominated and exhibits low flow conditions during routine monitoring trips. Point source contributors to the concerns we see in the segment may be traced back to permitted dischargers and storm water runoff. Additional monitoring within the segment may help determine the location of these potential point source influences, however additional monitoring sites viewed by the Authority's field staff have been concluded that none of the potential sites have had consistent flow. It is recommended that the Authority continues to seek additional, accessible monitoring locations.

White Deer Creek (Segment 0101C) 💧💧💧💧💧
Station 21174
White Deer Creek currently has no impairments or concerns. This segment continues to be monitored and assessed by the Authority as a reference site for the area. The Authority believes this water body to be spring fed. In May 2016, the Authority teamed up with the TCEQ and the TPWD and performed a Least Disturbed Stream study.

REACH II (Refer to map on page 35)

Lake Meredith (Segment 0102)
Stations 10036

While there are concerns within Segment 0102, Lake Meredith does have four (4) impairments which include mercury in edible fish tissue (2002), chloride, sulfate and TDS. According to data generated by the Texas Water Development Board, Lake Meredith had been at 0% percent full from May 2011 until June 2014. While it is likely that increased rainfall and an influx of water into Lake Meredith will address the chloride, sulfate and TDS impairments over time, the same is unfortunately not true for the mercury in edible fish tissue impairment. At the present time, TCEQ does not have enough funding to conduct another fish survey to either confirm and remove this impairment.

Big Blue Creek (Segment 0102A)
Station 15270

Big Blue Creek is currently not listed with any concerns nor impairments, based in the *2014 IR*. The segment continues to be monitored and assessed by the Authority as a reference site for the area.

Canadian River Above Lake Meredith (Segment 0103)
Stations 10054, 10056, 16344

The Canadian River Above Lake Meredith has been listed with a chloride impairment since 2006. This can be attributed primarily to naturally occurring salt deposits along the banks of the Canadian River, although the ever increasing abundance of salt cedar has certainly not helped matters. Not only does this invasive plant remove water from the stream, it deposits salt around itself, creating a salt-rich substrate uninhabitable to most other plants. These salt deposits can then be transferred into the stream contributing to larger concentrations chlorides. CRMWA has actively been removing salt cedar since 2004, treating some 26,000 plus acres during that time. While recent rains have helped, chloride concentrations are not likely to substantially improve until ample, consistent annual rainfall returns to the area.

Canadian River at US 287

East Amarillo Creek (Segment 0103A)
Stations 10017, 10018, 15775, 21024

This unclassified water body has no impairments, but is identified with concerns for both chlorophyll-*a* and nitrate. At its headwaters, it is heavily influenced by stormwater runoff from highly urbanized areas, further downstream by treated wastewater effluent from a permitted discharger, and finally by agricultural runoff. Nutrient rich runoff and wastewater effluent are most likely the source of the nitrate as elevated concentrations are not typically observed in the headwater portion of East Amarillo Creek. It is also very likely that, since a significant portion of the stream travels through unpopulated cropland, wildlife have a significant impact on the water quality, as well. It is important to note that Thompson Park Lake, which marks the headwaters of East Amarillo Creek, has had the highest mean chlorophyll-*a* values within the entire Canadian Basin. During normal and high flow conditions, when water from Thompson Park Lake flows over the spillway into East Amarillo Creek, it is a likely source of chlorophyll-*a* as well. Additional monitoring locations have added to address these concerns.

Unnamed Tributary to West Amarillo Creek (Segment 0103C) 🩸🩸🩸🩸

Station 10021, 17056

Unnamed Tributary to West Amarillo Creek is listed in the *2014 IR* with a single concern for chlorophyll-*a*. Additional monitoring further upstream has yielded no additional information regarding this concern.

REACH III (Refer to map on page 36)

Rita Blanca Lake (Segment 0105) 🩸

Station 10060

Rita Blanca Lake appears in the *2014 IR* with pH and chloride impairments. It should be noted that this is the only pH impairment within the entire Canadian River Basin. There are also concerns for chlorophyll-*a*, nitrate, ammonia and total phosphorus. Rita Blanca Lake has been a well-known migratory bird refuge, hence the nutrient related problems that have plagued the lake for several assessments, including the current *2014 IR*. Low annual rainfall and inflow of water into the lake make for a low lake turnover rate. This, coupled with the high volume of wildlife present year-round, are the primary source of its listings.

REACH IV (Refer to map on page 37)

Palo Duro Reservoir (Segment 0199A) 🩸🩸🩸🩸

Station 10005, 10007

Palo Duro Reservoir is included in the *2014 IR* with a single concern for total phosphorus. Additional monitoring will be required to better determine the source of the elevated nutrient.

REACH V (Refer to map on page 38)

Wolf Creek (Segment 0104) 🩸🩸🩸🩸

Stations 10058, 10059, 17465

Wolf Creek has a single concern for chlorophyll-*a* in the *2014 IR*. During the drought, the majority of the data was collected from the upper and middle portions of the segment at or below Lake Fryer. With reduced flow it is likely nutrients were able to assimilate here causing the elevated chlorophyll-*a* levels and biasing the data. Additional monitoring will be needed to confirm this assumption. Rainfall has allowed water quality data to be collected in the lower portion of the segment in the past year and should help in future assessments. In May 2016, the Authority partnered with the TCEQ and the TPWD to perform a Least Disturbed Stream study.

Kiowa Creek (Segment 0199B) - Not assessed in *2014 IR*

Station 10009

Until the TCEQ resumed monitoring in 2013, Kiowa Creek had not been monitored in almost a decade and therefore was not assessed during the development of the *2014 IR*. The Authority has recently taken over the monitoring duties of this water body. Unfortunately, this segment has been plagued by minimal events with no water.

Kiowa Creek at SH 15

Canadian River Basin
2014 Texas Integrated Report Summary Table

Reach	Segment Number	Segment Description	303(d) Impairments	Year First Listed	305(b) Concerns	Level of Concern
1	0101	Canadian River Below Lake Meredith	Bacteria	2012	Chlorophyll-*a* / Ammonia / Depressed DO	CS / CS / CN
1	0101A	Dixon Creek	Bacteria / Depressed DO / Selenium in Water	2000/2000/2010	Chlorophyll-*a* / Nitrate	CS / CS
1	0101B	Rock Creek	N/A	N/A	Nitrate / Chlorophyll-*a* / Total Phosphorus	CS / CS / CS
1	0101C	White Deer Creek	N/A	N/A	N/A	N/A
2	0102	Lake Meredith	Mercury in Edible Tissue / Chloride / Sulfate / TDS	2002 / 2006 / 2006 / 2006	N/A	N/A
2	0102A	Big Blue Creek	N/A	N/A	N/A	N/A
2	0103	Canadian River Above Lake Meredith	Chloride	2006	Bacteria	CN
2	0103A	East Amarillo Creek	N/A	N/A	Chlorophyll-*a* / Nitrate	CS / CS
2	0103C	Unnamed Tributary to West Amarillo Creek	N/A	N/A	Chlorophyll-*a*	CS
3	0105	Rita Blanca Lake	pH / Chloride	2006 / 2014	Ammonia / Chlorophyll-*a* / Nitrate / Total Phosphorus	CS / CS / CS / CS
4	0199A	Palo Duro Reservoir	N/A	N/A	Total Phosphorus	CS
5	0104	Wolf Creek	N/A	N/A	Chlorophyll-*a*	CS

RED RIVER BASIN

REACH I LOWER (Refer to map on page 39)

Lower Red River (Segment 0201) 🩸🩸🩸🩸
Station 10123
Like the other Red River segments (0202, 0203, 0204 and 0205), the Lower Red River is listed in the *2014 IR* with a single concern for chlorophyll-*a*. While the exact source is unknown, it is likely influenced by segments preceding it to the west. Water Quality information from the Oklahoma Department on Environmental Quality could also help determine whether or not there are influences from Oklahoma tributaries.

Mud Creek (Segment 0201A) 🩸
Station 15319
Mud Creek is listed in the *2014 IR* with impairments for bacteria and depressed dissolved oxygen. Ammonia and depressed dissolved oxygen are also listed as concerns. This is primarily due to the fact that much of the creek runs through privately owned property and the creek itself is plagued with beaver dams that prevent consistent flow. Low or no flow, coupled with agricultural nutrient-rich runoff, create an environment favorable for bacterial growth. The Authority has monitored Mud Creek in the past in an attempt to isolate the source of bacteria, with unsuccessful results. Therefore, the Authority has plans to conduct 24-hour dissolved oxygen studies to better determine the problem at hand. However, until consistent flow is present, these studies can not be completed and the water quality will struggle to improve.

Barkman Creek (Segment 0201D) - Not assessed in *2014 IR*
Station 15059
Barkman Creek was not assessed during the *2014 IR* due to insufficient data. The water body is currently being monitored by the Authority at one site.

Red River Below Lake Texoma (Segment 0202) 🩸🩸🩸🩸
Stations 10125, 10126, 10127, 13684, 21031
A single concern for chlorophyll-*a* is currently the only listing in the *2014 IR* for the Red River Below Lake Texoma. All segments above Segment 0202 (Red River Below Pease River - 0205, Red River Above Lake Texoma - 0204 and Lake Texoma - 0203) and several sub-segments also have a concern for chlorophyll-*a*.

Bois D' Arc Creek (Segment 0202A) 🩸🩸🩸🩸🩸
Stations 15036, 18652, 20167, 21029
Bois D' Arc Creek has no impairments or concerns in the *2014 IR*. The water body was recently delisted on two separate occasions for a bacteriological impairment and it is hopeful that joint monitoring efforts between the Authority and the North Texas Municipal Water District will continue to produce enough data to keep this off future *IR*'s.

Pecan Bayou (Segment 0202C) 🩸🩸🩸🩸🩸
Station 14472, 16001
Pecan Bayou has no impairments or concerns in the *2014 IR*. Pecan Bayou has little to no flow, although water is always present during monitoring events. The water body travels through undisturbed, privately owned land for most of its length.

Pine Creek (Segment 0202D) 🩸🩸🩸🩸
Station 10120
Pine Creek has no impairments but is identified for a chlorophyll-*a* concern in the *2014 IR.* Additional monitoring within the water body may be needed to determine the source of the elevated concentrations. However, this may be rather difficult to isolate due to the majority of the water body being located on private property.

Smith Creek (Segment 0202G) 🩸🩸
Station 17044, 21026, 21027
Smith Creek is listed in the *2014 IR* for a bacteria impairment, along with concerns for ammonia and total phosphorus. Smith Creek is

Smith Creek (Segment 0202G) Continued 🩸🩸🩸

Station 17044, 21026, 21027

considered to be a perennial stream due to the significant effluent contributions of a permitted discharger. As a primarily effluent dominated stream, the creek characteristically has elevated nutrient levels (concerns). Although portions of the creek and several small tributaries in the upstream portion of the segment may influence the lower portion of the segment, current monitoring efforts have yet to find elevated bacteria levels there. It has been hypothesized that during heavy rainfall events, significant urban runoff does influence bacteria loading downstream, however this has not been proven. Additional monitoring conducted by the Authority during the past several years has never shown bacteria levels upstream to be consistent with those found below the permitted discharger. It is recommended that Authority continues to work with TCEQ and other entities to help address the water quality concerns and impairments for this segment.

Smith Creek at CR31700

Big Pine Creek (Segment 0202H) 🩸🩸🩸🩸🩸

Station 18513

Big Pine Creek is not listed with any impairments nor concerns in the *2014 IR.* The segment was not monitored in FY 2015, but was picked up by the Authority in 2016 to be monitored on a quarterly basis. Little to no flow has been recorded at this site on every trip by the Authority's field staff. Increased monitoring of this segment will give us more insight on the overall water quality.

Little Pine Creek (Segment 0202I) 🩸

Station 18514

Little Pine Creek is currently listed in the *2014 IR* with an impairment for depressed dissolved oxygen, as well as concerns for chlorophyll-*a* and depressed dissolved oxygen. Additional monitoring within the water body will be required to identify a potential source of the contaminants.

Honey Grove Creek (Segment 0202L) 🩸🩸

Station 21030

Honey Grove Creek is listed in the *2014 IR* with no impairments, but it does have concerns for chlorophyll-*a*, total phosphorus and bacteria. The North Texas Municipal Water District is currently monitoring the water quality at this location monthly. This will provide much needed data to analyze in an effort to determine any correlations between routine water quality parameters and elevated nutrient concentrations.

Lake Bonham (Segment 0202M) 🩸🩸🩸🩸

Station 21032

Lake Bonham is not listed with any impairments in the *2014 IR*, but it does have a single concern for chlorophyll-*a*. The North Texas Municipal Water District is currently monitoring monthly at this location. This should provide much needed data to analyze to determine any correlations between routine water quality parameters and elevated nutrient concentrations. However, it should be noted that elevated concentrations of chlorophyll-*a* are present in several water bodies flowing into Lake Bonham.

Hicks Creek (Segment 0202N) - Not assessed in *2014 IR*
Station 10121, 10122
Hicks Creek was not assessed during the *2014 IR* due to insufficient data. The water body is currently being monitored by the Authority.

Six Mile Creek (Segment 0202P) - Not assessed in *2014 IR*
Station 21298
Six Mile Creek was not assessed during the *2014 IR* due to insufficient data. The water body is currently being monitored by the Authority.

Lake Crook (Segment 0208) 💧💧💧💧💧
Station 10137
Lake Crook is not listed with any impairments nor concerns in the *2014 IR*. The segment is currently being monitored by the TCEQ.

Pat Mayse Lake (Segment 0209) 💧💧💧
Stations 16342, 16343
Located 15 miles north of Paris, Texas in Lamar County, Pat Mayse Lake is currently listed in the *2014 IR* with concerns for both chlorophyll-*a* and manganese in sediment. This segment is currently being monitored and evaluated by TCEQ regional staff.

REACH I UPPER **(Refer to map on page 41)**

Post Oak Creek (Segment 0202E) 💧💧💧
Stations 10114, 10115, 17599, 21130
Post Oak Creek is listed in the *2014 IR* with concerns for nitrate and total phosphorus. While a point source has not been identified, extensive water quality monitoring conducted by the City of Sherman at multiple stations within this segment will hopefully identify a source in the future.

Choctaw Creek (Segment 0202F) 💧💧
Stations 10111, 10112, 18370
Choctaw Creek is located in a semi-urbanized area of Grayson county. There is a single impairment for bacteria, along with concerns for nitrate and total phosphorus. This could be related to urban runoff and/or influenced from Post Oak Creek. Additional monitoring will help identify potential sources contributing to the elevated concentrations. Due to the limited access, an RUAA was conducted to help determine whether or not assigned bacteriological standards are appropriate based on the assigned use. The study has been completed and submitted to TCEQ for review.

Sand Creek (Segment 0202J) 💧💧💧💧💧
Station 15446
Sand Creek is not listed with any impairments nor concerns in the *2014 IR*. The segment continues to be monitored and assessed for use as a reference site for the area. The segment is currently being monitored by the City of Sherman.

Six Mile Creek at FM195

Iron Ore Creek (Segment 0202K) 🩸🩸🩸

Station 18653

Iron Ore Creek is listed with a single bacteria impairment in the *2014 IR*. The creek meanders through privately owned property for much of its length. Factors like this made the water body a prime candidate for a recent RUAA project to help determine whether or not assigned bacteriological standards are appropriate based on the assigned use. The study has been completed and submitted to TCEQ for review.

Pickens Lake (Segment 0202O) - Not assessed in *2014 IR*

Station 16945

Pickens Lake was not assessed during the *2014 IR* due to insufficient data. The water body is currently being monitored by the City of Sherman.

Lake Texoma (Segment 0203) 🩸🩸

Stations 10130 10131, 15388, 17480, 20545

Lake Texoma has no current impairments, but has two concerns including chlorophyll-*a* and harmful algal blooms - golden alga. Chlorophyll-*a* concentrations observed during routine monitoring are most likely influenced by segments upstream, specifically Segment 0204, which has similar concerns. It is important to note the ongoing zebra mussel infestation at Lake Texoma which is being monitored by the USGS.

Big Mineral Creek (Segment 0203A) 🩸🩸🩸

Station 17505

Big Mineral Creek influences Lake Texoma and was found to have no impairments when assessed in the *2014 IR*. The segment does have a concerns for nitrate and total phosphorus. This is currently being monitored and evaluated by TCEQ regional staff.

Red River Above Lake Texoma (Segment 0204) 🩸🩸🩸🩸

Stations 10132, 10133, 20168

The Red River Above Lake Texoma has a single concern for chlorophyll-*a*. It is difficult to identify a single source of the concern, considering how many tributaries flow into segment 0204 from both the Texas and Oklahoma side of the Red River. One possibility is the influence from such tributaries. Another may coincide with the amount of agricultural runoff that the Red River and its tributaries receive. Nutrient-rich agricultural runoff would promote chlorophyll-*a* concentrations within the water body. Increased monitoring of tributaries, along with a push to receive and review data from the Oklahoma Department on Environmental Quality, may shed light on problematic areas. Once identified, remediation efforts can take place, leading to a reduction in the nutrient load this segment receives.

Moss Lake (Segment 0204B) 🩸🩸🩸🩸🩸

Station 15447

Moss Lake is not listed with any impairments or concerns in the *2014 IR*. The segment is currently being monitored by the Authority.

Farmers Creek Reservoir (Segment 0210) 🩸🩸🩸🩸🩸

Station 10139

Farmers Creek Reservoir, more commonly referred to as Lake Nocona, is formed by a dam on Farmers Creek, northeast of Nocona, in Montague County. It was constructed for municipal water supply and recreation in 1961. It is not listed with any impairments nor concerns in the *2014 IR*. The Authority has been monitoring the reservoir on a quarterly basis since 2011.

REACH II **(Refer to map on page 41)**

Little Wichita River (Segment 0211) 🩸

Stations 10140, 13633,

A depressed dissolved oxygen impairment has plagued this segment since 1996. Increasing concentrations of chloride, sulfate and total dissolved solids (TDS) led to additional impairments with the approval of the *2010/2012 IR* which also appear in the *2014 IR*. Additionally, there are concerns for both chlorophyll-*a* and bacteria. While portions of the Wichita River are heavily impacted by naturally occurring salt deposits, these issues were magnified during the drought which had plagued much of the basin through May 2015.

East Fork Little Wichita River (Segment 0211A) 💧💧💧💧💧
Stations 10105
The East Fork Little Wichita River is not listed with any impairments nor concerns in the *2014 IR.* It is currently being monitored by TCEQ and the USGS.

Lake Arrowhead (Segment 0212) 💧💧💧💧💧
Station 10142
Located 14 miles southeast of Wichita Falls, Lake Arrowhead covers approximately 524 acres in Clay County and serves as a public water supply for the City of Wichita Falls. It is not listed for any impairments or concerns in the *2014 IR*. Despite reaching record lows during the drought, the lake did receive enough inflow during May 2015 to reach 100% capacity and flow over the spillway

Little Wichita River Above Lake Arrowhead (Segment 0206A) - Not assessed in *2014 IR*
Station 16038
The Little Wichita River Above Lake Arrowhead was not assessed during the *2014 IR* due to insufficient data. The water body is currently being monitored by TCEQ and the USGS.

Lake Kickapoo (Segment 0213) 💧💧💧💧💧
Station 10143
Lake Kickapoo is located 30 miles southwest of Wichita Falls. It currently has no impairments or concerns in the *2014 IR*. It has been used by the Authority as a reference water body for this area of the basin. Torrential rains occurring during May 2015 helped Lake Kickapoo reach 100% capacity and flow over its spillway, ultimately flowing into Lake Arrowhead further downstream to help it reach 100% capacity as well.

Wichita River Below Lake Diversion Dam (Segment 0214) 💧💧
Stations 10145, 10148, 10150, 10151, 10154, 10155
The Wichita River below Lake Diversion Dam has been listed in the *2014 IR* for a bacteria impairment. While there is no bacteria impairment for Lake Diversion, Segment 0215, there are bacteriological impairments on Segment 0214A (Beaver Creek) and Segment 0214B (Buffalo Creek), both of which have confluences with Segment 0214. The Wichita River Below Lake Diversion Dam also has concerns for chlorophyll-*a*, nitrate and total phosphorus. These elevated nutrient levels can also be attributed to the two sub-segments, as well as agricultural run-off from the countryside it travels through before flowing through the City of Wichita Falls.

Beaver Creek (Segment 0214A) 💧
Stations 15120, 15121
Beaver Creek is listed in the *2014 IR* for a bacteria impairment, along with concerns for both chlorophyll-*a* and depressed dissolved oxygen. The creek flows primarily through uninhabited countryside used for agricultural purposes. Nutrient-rich runoff may be contributing to the elevated chlorophyll-*a* values observed during routine monitoring. Nutrient-rich runoff could create an ideal environment to support various types of aquatic vegetation. This aquatic vegetation would explain the elevated concentrations of chlorophyll-*a*, and may also account for the low dissolved oxygen levels. Low dissolved oxygen levels can be heavily influenced by established communities of aquatic vegetation using it for respiration. Additionally, the low flows observed during the drought would not have promoted good dissolved oxygen concentrations either. Either one of these situations, or a combination thereof, could help explain the low dissolved oxygen concentrations. The Authority is planning to conduct 24-Hour dissolved oxygen studies to better assess the situation.

Buffalo Creek (Segment 0214B) 💧💧
Station 10097, 16036, 20162, 17947
Buffalo Creek has historically been monitored by the Authority at one location, Station 10097. However, the persistence of elevated bacteria levels, which ultimately led to its first impairment listing for the analyte in the *2010 IR*, triggered the Authority to add an additional monitoring station upstream. Station 16036 was added and has been monitored ever since. The return of rain fall to the area has promoted a steady flow at 16036. The additional flow upstream could potentially minimize the elevated bacteria levels showing up downstream.

Holliday Creek (Segment 0214C)

Station 10095, 21025

Holliday Creek is not listed with any impairments nor concerns in the *2014 IR*. It is currently being monitored by the Authority and the USGS.

Gordon Lake (Segment 0214D)

Station N/A

Gordon Lake is not listed with any impairments nor concerns in the *2014 IR*. It is currently not being monitored.

Wichita Valley Irrigation Project (Segment 0214E)

Station 18831

The Wichita Valley Irrigation Canal originates just below the Lake Diversion Spillway. The segment is listed in the *2014 IR* with a single concern for chlorophyll-*a*. Ironically, this concern is not found in Diversion Lake. One possible explanation could be the lack of water being released from Lake Diversion into the irrigation canal. With the onset and persistence of the most recent drought, the Wichita Falls Irrigation District was forced to stop providing water through the canal system. Thus, the regular release of water which flooded the canal was not available to scour it and keep aquatic vegetation at bay. This may have allowed aquatic vegetation to bloom when it would not have had the opportunity during "normal" conditions. Additional monitoring will be required to evaluate this concern.

Unnamed Trib. to Buffalo Creek (Segment 0214F)

Station 21172

The Unnamed Tributary to Buffalo Creek is not listed in the *2014 IR* with any impairments nor concerns. The water body was originally monitored in response to the long standing bacteriological impairment observed in Buffalo Creek (0214B). Recent monitoring has shown a strong correlation between both bacteriological and nutrient concentrations between the two water bodies. The Authority will continue to monitor both in an effort to better evaluate the impact this water body has on other streams in the area.

Diversion Lake (Segment 0215)

Station 10157

Located 30 miles from Wichita Falls on the Archer/Baylor County line, Diversion Lake is listed in the *2014 IR* with a single concern for harmful algal blooms, primarily golden alga. Already low annual rainfall, coupled with the subsequent decreasing rainfall the area has received up until May 2015, took a toll on the Lake Diversion. Although not listed as concerns, elevated concentrations of naturally occurring chloride and sulfate flowing through the Lake Kemp system have created an environment well-suited for the algae that have recently plagued Diversion Lake and could explain why more and more golden alga blooms have been exhibited.

Wichita River Below Lake Kemp (Segment 0216)

Station 10158

This segment is currently being monitored by the USGS and the Authority. It is not listed for any impairments nor concerns in the *2014 IR*.

Wichita River at US 283

Lake Kemp (Segment 0217) 💧💧💧💧💧

Station 10159

Lake Kemp has been used by the Authority as a reference water body for this area of the basin. The lake has been monitored for several years due to its importance as a drinking water reserve for the City of Wichita Falls' wholesale and municipal customers. The *2014 IR* lists no impairments nor concerns for Lake Kemp.

Wichita/North Fork Wichita River (Segment 0218) 💧💧💧💧

Stations 10161, 10162, 15119

The *2014 IR* lists a single concern for bacteria in this segment. The majority of Segment 0218 is located on privately owned property in rural areas, drastically reducing the number non-point and/or point sources which could be impacting it. Continued monitoring will be needed to further evaluate this concern.

Middle Fork Wichita River (Segment 0218A) 💧💧💧💧

Station 14900

The *2014 IR* lists a single concern for selenium in water. This is thought to be naturally occurring. The USGS is evaluating this in hopes of a delisting during a future assessment and no additional selenium in water samples are being collected.

Lake Wichita (Segment 0219) 💧

Station 10163

Lake Wichita was found to have three impairments in the *2014 IR* including chloride, sulfate and TDS, along with concerns for chlorophyll-*a*, harmful algal blooms (golden algae) and total phosphorus. Lake Wichita has been a great place for locals to enjoy several forms of primary contact recreation. However, past flood control issues led to a dam modification that has reduced the turnover rate of the lake significantly. This has led to continuous siltation of Lake Wichita, leading to depths as shallow as three feet in several areas, including mid-lake. During the drought, concentrations for dissolved solids and other analytes skyrocketed to concentrations never before observed. A local stakeholder group, the Lake Wichita Revitalization Committee, is working to raise funds to ultimately dredge Lake Wichita in an effort to restore the water body back to its original state. This, along with continued rain, could reduce the dissolved solids concentrations and likely help with the nutrient assimilation and golden algae blooms that have been observed over the recent years.

Holiday Creek Above Lake Wichita (Segment 0219A) 💧💧💧💧💧

Station N/A

The Upper Pease/North Fork Pease River is not listed with any impairments nor concerns in the *2014 IR.* The segment is currently not being monitored.

South Fork Wichita River (Segment 0226) 💧💧💧💧

Stations 10185, 13636

Segment 0226 is listed for a single concern for ammonia. While there is no known point source identified for the ammonia within the segment, it is most likely a combination of runoff originating from the predominantly agricultural land it flows through and the river's use by various types of wildlife throughout the segment. The Authority added an additional monitoring site, 13636, to help identify locations where ammonia concentrations are elevated.

Lake Wichita

Red River at US 277/281

REACH III (Refer to map on page 43)

Red River Below Pease River (Segment 0205) 🩸🩸🩸🩸
Station 10134, 16733
Like the other Red River Segments (0201, 0202, 0203, and 0204), the Red River below the Pease River is troubled with a concern for chlorophyll-*a*. Like its counterparts, the most likely causes stem from runoff along the banks of the Red River and its several tributaries. Information regarding water quality from tributaries originating in Oklahoma could be beneficial when determining the best method for remediating this segment and other segments of the Red River.

Wildhorse Creek (Segment 0205A) 🩸🩸🩸🩸🩸
Station 10096
Wildhorse Creek was not assessed during the *2014 IR* due to insufficient data. The water body is currently being monitored by the Authority.

Red River Above Pease River (Segment 0206) 🩸🩸🩸🩸🩸
Station 10135
The Red River Above the Pease River is not listed with any impairments nor concerns in the *2014 IR*. The segment is currently being monitored by the Authority.

Groesbeck Creek (Segment 0206A) - Not assessed in *2014 IR*
Station 20166
Groesbeck Creek was not assessed during the *2014 IR* due to insufficient data. The water body is currently being monitored by the Authority and the USGS.

South Groesbeck Creek (Segment 0206B) 🩸🩸
Station 16000
South Groesbeck Creek is a slow-moving stream that travels through privately owned property used for agricultural purposes. The segment is listed in the *2014 IR* with a bacteria impairment and a concern for nitrate. The likely culprit for these water quality issues is runoff occurring along the segment during rainfall events. The Authority is currently conducting additional monitoring at Station 20166, located upstream of the current monitoring station at SH 6 north of the City of Quanah, in an effort to better identify point sources of pollution contributing to the water quality issues.

North Groesbeck Creek (Segment 0206C) - Not assessed in *2014 IR*
Station 21297
North Groesbeck Creek was not assessed during the *2014 IR* due to insufficient data. The water body is currently being monitored by the Authority.

Upper Pease/North Fork Pease River (Segment 0220) 🩸🩸🩸🩸🩸
Station 10167
The Upper Pease/North Fork Pease River is not listed with any impairments nor concerns in the *2014 IR*. The segment is currently being monitored by the Authority.

Middle Fork Pease River (Segment 0221) 🩸🩸🩸🩸🩸

Station 10169, 10170

The Middle Fork Pease River is not listed with any impairments nor concerns in the *2014 IR*. The segment is currently being monitored by the Authority as a result of discussions from the annual Coordinated Monitoring Meeting in 2016.

Pease River (Segment 0230) 🩸🩸🩸🩸🩸

Station 10165, 10166

The Pease River is currently not listed for any impairments nor concerns, according to the *2014 IR*. However, it is important to note that several portions of the segment were dry for extended periods of time during the most recent drought. In response, the Authority has begun monitoring at additional locations within Segment 0230 and its unclassified water bodies. A better assessment of water quality throughout the segment's entirety will help ensure water quality issues are identified before they become concerns, and/or impairments in the future.

Paradise Creek (Segment 0230A) 🩸🩸

Station 10094

Paradise Creek is listed in the *2014 IR* with a single impairment for bacteria and a concern for chlorophyll-*a*. The recent drought is likely responsible. This segment also has varying degrees of development and is influenced by both urban and agricultural runoff. Thus, when rainfall occurs, nutrient and bacteria-rich runoff significantly impact the stream leading to increased bacteria values and a water column loaded with nutrients that benefit algal growth. The return of constant flow may remediate some of these issues, and will allow current water quality data to be collected and assessed.

REACH IV **(Refer to map on Page 44)**

Lower Prairie Dog Town Fork Red River (Segment 0207) 🩸🩸

Stations 10136, 13637, 16037

The Lower Prairie Dog Town Fork Red River (LPDTF) is listed in the *2014 IR* for a bacteriological impairment and has a concern for chlorophyll-*a*. LPDTF is plagued by extremely low flows and high naturally occurring salt contamination. Ironically, Segment 0207 was assigned the bacteriological impairment from *E. coli* data, despite having *Enterococcus* listed as the indicator bacteria. Research has shown that E. coli may not be as good of an indicator of fecal contamination in high-saline water bodies, hence the different indicator bacteria. It is hopeful that once enough Enterococcus data has been collected for assessment purposes, the data will no longer show the water body to be impaired.

Buck Creek (Segment 0207A) 🩸🩸🩸🩸

Stations 15811, 20366

Buck Creek is listed in the *2014 IR* with a single concern for nitrate. Since groundwater in this area has some of the highest median nitrate values in the state, there is a possibility that naturally occurring springs may be contributing to the elevated nitrate concentrations. With the availability of water in this segment during recent monitoring trips, the Authority hopes that the collection of data will help address the concern for nitrate.

Buck Creek at US 83

Mackenzie Reservoir (Segment 0228) 🩸🩸🩸

Station 10188

Mackenzie Reservoir became listed for a TDS impairment in the *2014 IR*. The persistence of the most recent drought is likely the culprit for the progressive increase in TDS observed during routine monitoring events. As regular rainfall returns to the area, a decrease in TDS and other dissolved solid concentrations should be observed.

Upper Prairie Dog Town Fork Red River (Segment 0229) 🩸

Stations 10191, 20801

The Upper Prairie Dog Town Fork Red River (UPDTF) is listed in the *2014 IR* with a pH impairment, the only pH impairment within the Red River Basin. Additionally, it is listed with concerns for bacteria, chlorophyll-*a*, depressed dissolved oxygen, nitrate and total phosphorus. A change in the monitoring location of this segment has led to much lower pH values during routine monitoring events. Should this trend continue, there will be enough data during the *2016 IR* to remove the pH impairment. As for the concerns, it is likely that since the headwaters of this segment originate from Lake Tanglewood, that no change will be seen until improvements are made in Segment 0229A.

Lake Tanglewood (Segment 0229A) 🩸🩸

Station 10192

Lake Tanglewood has no impairments according to the *2014 IR*, but does have concerns for depressed dissolved oxygen, chlorophyll-*a*, nitrate, ammonia and total phosphorus. Although a point source has not been identified, research does indicate that the nearby community was constructed before current standards for septic systems were in place. It is a possibility that some antiquated septic systems are now failing and contributing to the concerns listed in the *2014 IR*. Additional research and monitoring will be required to identify the source of elevated contamination concentrations before remediation can occur.

Tierra Blanca Creek (Segment 0299B) - Not assessed in *2014 IR*

Station 10065

Tierra Blanca Creek was not assessed during the *2014 IR* due to insufficient data. The water body is not currently being monitored. Until regular rainfall returns to this area, it is likely that there will not be enough water to determine water quality at this location

LPDTF Red River at SH 207

REACH V (Refer to map on page 45)

Salt Fork Red River (Segment 0222) 🩸🩸🩸
Stations 10171, 10172
The Salt Fork of the Red River is listed in the *2014 IR* with an impairment for bacteria and a concern for nitrate. At this time, a potential source has not been identified.

Lelia Lake Creek (Segment 0222A) 🩸🩸🩸🩸🩸
Station 10076
Lelia Lake Creek is not listed with any impairments nor concerns in the *2014 IR.* The segment is currently being monitored by both the TCEQ and the USGS.

Greenbelt Lake (Segment 0223) 🩸🩸🩸🩸🩸
Station 10173
Greenbelt Lake is not listed with any impairments nor concerns in the *2014 IR.* The segment is currently being monitored by the TCEQ.

North Fork Red River (Segment 0224) 🩸🩸🩸🩸🩸
Station 10178, 10179
The North Fork of the Red River is not listed with any impairments nor concerns in the *2014 IR.* The segment is currently being monitored by the Authority.

McClellan Creek (Segment 0224A) 🩸🩸🩸
Station 10064
McClellan Creek was first listed for a bacteria impairment in the *2010 IR*. The segment is primarily located on privately owned land with relatively no public access. During routine monitoring, Authority staff have observed several wildlife in the area, which may be associated with the elevated bacteria levels. Additional monitoring will be necessary to determine if other pollution sources exist. It is the Authority's desire to implement biological monitoring in this segment.

Sweetwater Creek (Segment 0299A) 🩸🩸🩸🩸🩸
Stations 10070, 10072
Sweetwater Creek's bacteria impairment was removed in the *2014 IR* and now has no impairments or concerns. This creek primarily flows through privately owned countryside used for varying degrees of agricultural production. There is little to no influence from industry or urbanized areas. Factors like this made the water body a prime candidate for a recent RUAA project to help determine whether or not assigned bacteriological standards are appropriate based on the assigned use.

North Fork Red River at FM 2473

Red River Basin
2014 Texas Integrated Report Summary Table

Reach	Segment Number	Segment Description	303(d) Impairments	Year First Listed	305(b) Concerns	Level of Concern
Lower 1	0201	Lower Red River	N/A	N/A	Chlorophyll-*a*	CS
Lower 1	0201A	Mud Creek	Bacteria / Depressed DO	2002 / 2006	Ammonia / Depressed DO	CS / CS
Lower 1	0202	Red River Below Lake Texoma	N/A	N/A	Chlorophyll-a	CS
Lower 1	0202A	Bois D' Arc Creek	N/A	N/A	N/A	N/A
Lower 1	0202C	Pecan Bayou	N/A	N/A	N/A	N/A
Lower 1	0202D	Pine Creek	N/A	N/A	Chlorophyll-*a*	CS
Lower 1	0202G	Smith Creek	Bacteria	2006	Ammonia / Total Phosphorus	CS / CS
Lower 1	0202H	Big Pine Creek	N/A	N/A	N/A	N/A
Lower 1	0202I	Little Pine Creek	Depressed DO	2014	Chlorophyll-*a* / Depressed DO	CS / CS
Lower 1	0202L	Honey Grove Creek	N/A	N/A	Chlorophyll-*a* / Total Phosphorus / Bacteria	CS / CS / CN
Lower 1	0202M	Lake Bonham (Bonham City Lake)	N/A	N/A	Chlorophyll-*a*	CS
Lower 1	0208	Lake Crook	N/A	N/A	N/A	N/A
Lower 1	0209	Pat Mayse Lake	N/A	N/A	Chlorophyll-*a* / Manganese in Sediment	CS / CS
Upper 1	0202E	Post Oak Creek	N/A	N/A	Nitrate / Total Phosphorus	CS / CS
Upper 1	0202F	Choctaw Creek	Bacteria	2010	Nitrate / Total Phosphorus	CS / CS
Upper 1	0202J	Sand Creek	N/A	N/A	N/A	N/A
Upper 1	0202K	Iron Ore Creek	Bacteria	2010	N/A	N/A
Upper 1	0203	Lake Texoma	N/A	N/A	Chlorophyll-*a* / Harmful Algal Bloom-Golden Alga	CS / CN
Upper 1	0203A	Big Mineral Creek	N/A	N/A	Nitrate / Total Phosphorus	CS / CS
Upper 1	0203C	Mustang Creek	N/A	N/A	N/A	N/A
Upper 1	0203D	Deaver Creek	N/A	N/A	N/A	N/A
Upper 1	0204	Red River Above Lake Texoma	N/A	N/A	Chlorophyll-*a*	CS
Upper 1	0204B	Moss Lake	N/A	N/A	N/A	N/A
Upper 1	0210	Farmers Creek Reservoir	N/A	N/A	N/A	N/A
2	0211	Little Wichita River	Chloride / Sulfate / TDS / Depressed DO	2012 / 2010 2010 / 1996	Chlorophyll-*a* / Bacteria	CS / CN
2	0211A	East Fork Little Wichita River	N/A	N/A	N/A	N/A
2	0212	Lake Arrowhead	N/A	N/A	N/A	N/A
2	0212A	Little Wichita River Above Lake Arrowhead	N/A	N/A	N/A	N/A
2	0213	Lake Kickapoo	N/A	N/A	N/A	N/A
2	0214	Wichita River Below Diversion Lake Dam	Bacteria	2006	Chlorophyll-*a* / Nitrate / Total Phosphorus	CS / CS / CS
2	0214A	Beaver Creek	Bacteria	2006	Chlorophyll-*a* / Depressed DO	CS / CN

Red River Basin

2014 Texas Integrated Report Summary Table (continued)

Reach	Segment Number	Segment Description	303(d) Impairments	YearFirst Listed	305(b) Concerns	Level of Concern
2	0214B	Buffalo Creek	Bacteria	2010	Ammonia / Chlorophyll-*a* / Nitrate Total Phosphorus	CS / CS / CS / CS
2	0214C	Holliday Creek	N/A	N/A	N/A	N/A
2	0214D	Gordon Lake	N/A	N/A	N/A	N/A
2	0214E	Wichita Valley Irrigation Project	N/A	N/A	Chlorophyll-*a*	CS
2	0214F	Unnamed Tributary to Buffalo Creek	N/A	N/A	N/A	N/A
2	0215	Diversion Lake	N/A	N/A	Harmful Algal Bloom-Golden Alga	CN
2	0216	Wichita River Below Lake Kemp	N/A	N/A	N/A	N/A
2	0217	Lake Kemp	N/A	N/A	N/A	N/A
2	0218	Wichita/North Fork Wichita River	N/A	N/A	Bacteria	CN
2	0218A	Middle Fork Wichita River	N/A	N/A	Selenium in Water	CN
2	0219	Lake Wichita	Chloride, Sulfate, TDS	2014 / 2014 / 2014	Chlorophyll-*a* / Harmful Algal Bloom -Golden Alga / Total Phosphorus	CS / CN / CS
2	0219A	Holiday Creek Above Lake Wichita	N/A	N/A	N/A	N/A
2	0226	South Fork Wichita River	N/A	N/A	Ammonia	CS
3	0205	Red River Below Pease River	N/A	N/A	Chlorophyll-*a*	CS
3	0205A	Wildhorse Creek	N/A	N/A	N/A	N/A
3	0206	Red River Above Pease River	N/A	N/A	N/A	N/A
3	0206B	South Groesbeck Creek	Bacteria	2006	Nitrate	CS
3	0220	Upper Pease/North Fork Pease River	N/A	N/A	N/A	N/A
3	0221	Middle Fork Pease River	N/A	N/A	N/A	N/A
3	0230	Pease River	N/A	N/A	N/A	N/A
3	0230A	Paradise Creek	Bacteria	2006	Chlorophyll-*a*	CS
4	0207	Lower Prairie Dog Town Fork Red River	Bacteria	2006	Chlorophyll-*a*	CS
4	0207A	Buck Creek	N/A	N/A	Nitrate	CS
4	0228	Mackenzie Reservoir	TDS	2014	N/A	N/A
4	0229	Upper Prairie Dog Town Fork Red River	pH	2006	Bacteria / Chlorophyll-*a* / Nitrate Total Phosphorus / Depressed DO	CN / CS / CS / CS / CS
4	0229A	Lake Tanglewood	N/A	N/A	Ammonia / Chlorophyll-*a* / Depressed DO / Nitrate / Total Phosphorus	CS / CS / CS / CS / CS
5	0222	Salt Fork Red River	Bacteria	2010	Nitrate	CS
5	0222A	Lelia Lake Creek	N/A	N/A	N/A	N/A
5	0223	Green Belt Lake	N/A	N/A	N/A	N/A
5	0224	North Fork Red River	N/A	N/A	N/A	N/A
5	0224A	McClellan Creek	Bacteria	2010	N/A	N/A
5	0299A	Sweetwater Creek	N/A	N/A	N/A	N/A

PUBLIC INVOLVEMENT AND OTHER INFORMATION

BASIN ADVISORY COMMITTEE

The Basin Advisory Committee (BAC), also known as the Steering Committee, is the driving force that assists in determining the water quality priorities of the CRP in the Canadian and Red River Basins. Representatives from the public, municipal, county, state and federal government, industry, business, agriculture, fee payers, environmental, education, civic organizations, and others comprise the membership of the BAC. Annual meetings are held in Amarillo and Wichita Falls and are open, friendly, casual, and informative.

RED RIVER VALLEY WATER RESOURCE CONFERENCE

The Red River Valley Water Resource Conference is hosted by the Authority in cooperation with the Red River Valley Association and comprises representatives from Texas, Oklahoma, Arkansas and Louisiana. The focus of the conference is water quality and quantity issues that affect everyone within the Red River Basin, in all four states. More information on the Red River Valley Water Resource Conference can be found at **www.rrva.org**.

EDUCATION

An important program sponsored by the Authority is the distribution of the *Major Rivers* educational program to schools within both basins. *Major Rivers* is a water education curriculum designed by the Texas Water Development Board and the Lower Colorado River Authority and teaches students about Texas' major water resources. Since 1998, the Authority has provided this curriculum to over 10,000 students in the Canadian and Red River Basins.

Since 2010, Midwestern State University students enrolled in environmental science courses were invited to the Authority's Environmental Services Laboratory for a tour and to witness real-world application of topics they had covered in both lecture and labs. This is a good opportunity to promote interest in the environmental sciences and to get the word out about the Clean Rivers Program.

COORDINATION WITH OTHER BASIN ENTITIES

The Authority coordinates collection and monitoring efforts with other basin entities by holding annual Coordinated Monitoring Meetings (CMM). Entities that have been included in these meetings are the TCEQ, USGS, CRMWA, City of Sherman, TPWD, Texas State Soil and Water Conservation Board, the North Texas Municipal Water District and the U.S. Army Corps of Engineers. Goals of this meeting are to coordinate sites, parameters of concern, and data collection frequency. The CMM solicits input from all entities involved in monitoring in order to create monitoring schedules that reduce duplicative efforts. This, in turn, maximizes the funds available for the program.

WATERSHED ACTION PLANNING (WAP)

The Watershed Action Planning (WAP) process is a tool to help coordinate, document and track progress on the state's water quality initiatives, specifically those water bodies with long standing 303(d) impairments. This tool was created with three objectives in mind:

1. Engage stakeholders more fully in determining strategies that restore water quality;
2. Improve access to state agencies' water quality management decisions and increase transparency of decision-making;
3. Improve accountability of state agencies' commitments to improve water quality.

The Authority has chosen to incorporate this process into our annual Coordinated Monitoring Meeting. The first attempt was made by the

Authority at the 2012 CMM and was a great success. The Authority plans to continue hosting both the WAP and CMM into one meeting.

ENVIRONMENTAL SERVICES LABORATORY

The Authority's laboratory achieved official NELAP accreditation in 2008. This insures that all samples tested comply with national standards of acceptance. NELAP quality assured data is used by the TCEQ in developing and revising water quality standards and evaluating whether those standards are met. Since the laboratory's initial NELAP accreditation, it has been audited by TCEQ in 2010, 2012 and 2015. The Authority's laboratory is currently accredited to perform analyses in both potable and non-potable matrices, as well as, solids.

The Authority's laboratory participated in an Extended Holding Time Study for *E. coli* bacteria in the spring and summer of 2009, as well as the most recent study, which took place during 2011-2012. The aim of the on-going bacteria project is to help regulators determine the effects of an extended holding time when making quantitative determinations of indicator bacteria like *E. coli*. Extended holding times are occasionally used during surface water quality monitoring events, since it is not always feasible to return samples to the laboratory and meet the required eight (8) hour holding time. Results of this study helped get EPA's approval of a thirty (30) hour holding time for *E. coli* beginning in August 2014.

RECOMMENDATIONS

The following recommendations are based upon the evaluations presented in this report and the *2014 Basin Summary Report of the Canadian and Red River Basins*. Comments received through public participation have also influenced these recommendations and conclusions. They are as follows:

COORDINATION/SPONSORSHIP

- Continue to promote and build upon the already successful annual Coordinated Monitoring Meeting to develop strategic monitoring plans for both basins. This reduces duplication of efforts, ensures the efficient use of available financial resources and increases the number of sites to be monitored. In addition, it enables the impairments and concerns, as defined in the *IR*, to be adequately addressed, so that all segments and water quality uses can be assessed.

- Continue to build upon the Watershed Action Planning process. This process emphasizes and promotes a cooperative effort to pursue monitoring based efforts to aid in

Pecan Bayour at FM 1159


Wolf Creek at FM 1454

both the identification of problems and/or sources of long-time 303(d) impairments and 305(b) concerns and their subsequent delisting and/or removal from such lists;

- Continue to increase the number of monitoring partners, in order for non-monitored locations or locations needing additional monitoring, to receive coverage. Thereby increasing the amount of data available for future water quality assessments. Increased coverage will provide additional data, useful in determining potential cause(s) for both impairments and concerns;

- Continue to encourage the State of Oklahoma environmental and water quality agencies to attend the Coordinated Monitoring and Basin Advisory Committee Meetings in order to further a cooperative effort in the improvement of water quality for both basins;

- Continue as the State Sponsor of the Red River Chloride Control Project, pressing for the project's funding and completion so that previously unusable water sources can be utilized without excessive treatment costs.

EDUCATION

- Continue to work with the agriculture and ranching industry and municipal entities toward the improvement of water quality through effective planning strategies and the implementation of Best Management Practices (BMPs);

- Continue educating students and other interested citizens and stakeholders in regards to the importance of water quality monitoring;

- Continue to publicly present new information regarding invasive plant and animal species, such as salt cedar and the zebra mussel. Through continued education efforts, we can take strides to reduce the transfer of these invasive species throughout Texas;

- Continue to participate in local initiatives, such as the annual Earth Day Program, to help garner the interest of children in an effort to promote water conservation and stewardship of water quality resources within both the Canadian and Red River Basins.

ANALYTICAL

- Continue to work with TCEQ and other data submitters to develop methodologies that support reducing the percentages of censored data submitted to TCEQ's Surface Water Quality Monitoring Database (SWQMIS);

- Continue to support TCEQ in its efforts to expand conventional monitoring through the analyses of additional parameters, especially those pertinent to the development of numeric nutrient criteria, including total kjeldahl nitrogen (TKN), nitrate+nitrite, ammonia and chlorophyll-*a*;

- Continue to promote and collect *Enterococcus* data to better assess the bacteriological quality in high saline water bodies throughout the Canadian and Red River Basin. Of all the 303(d) impaired water bodies assessed during the *2014 IR*, approximately 20+% of those have been identified as utilizing *Enterococcus*, in lieu of *E. coli*, as the indicator bacteria for that segment. Once enough data is available, and these water bodies can be more accurately assessed, it may be determined that some of the original listings were made in error and those water bodies can be removed from future *IR's*.

STANDARDS

- Continue to support the development of new standards, such as those seen in the *2014 Texas Surface Water Quality Standards*, that more accurately define criteria for contact recreation;

- Continue to support the completion of Recreational Use Attainability Analysis (RUAA) throughout the Canadian and Red River Basins. The completion of these studies helps determine whether or not established use categories are actually appropriate for the said water body. In cases where the use classification is not appropriate, it can be reclassified which can lead to a less stringent bacteria standard, potentially leading to that water body being removed and delisted for a bacteriological (*E. coli* or *Enterococcus* MPN) impairment;

- Continue to support the development of achievable numeric nutrient criteria that encompass the best interests of both the stakeholders and permittees, as well as the TCEQ.

MONITORING

- Increase the number of monitoring partners in order for non-monitored locations to receive additional coverage, thereby increasing the amount of data available for future water quality inventories. Increased coverage will allow for more reliable data in determining the cause(s) for impairments and concerns;

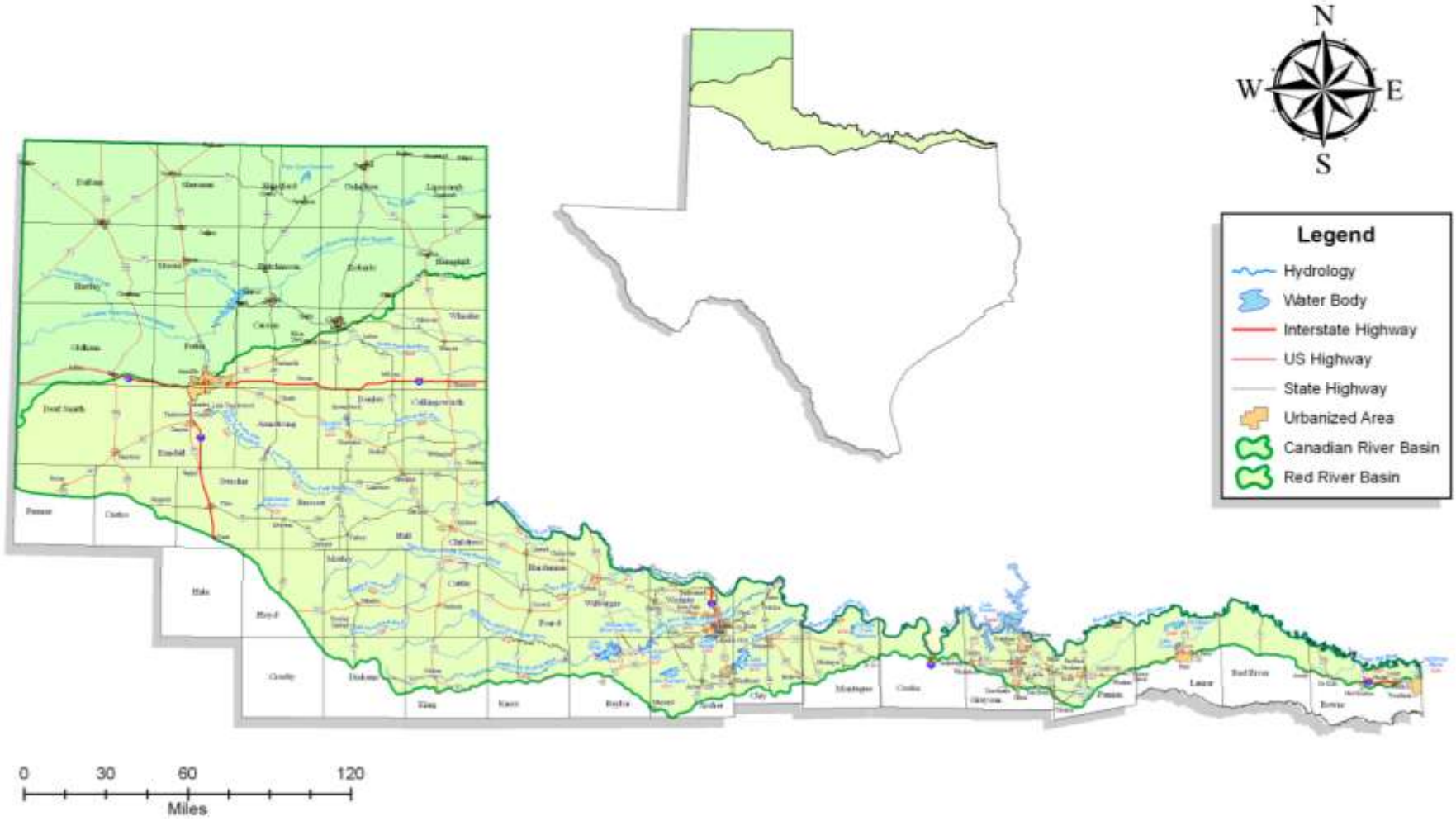
- Increase the number of monitoring locations throughout the Canadian and Red River Basins to provide TCEQ with more data to aid in the evaluation of watersheds throughout both basins;

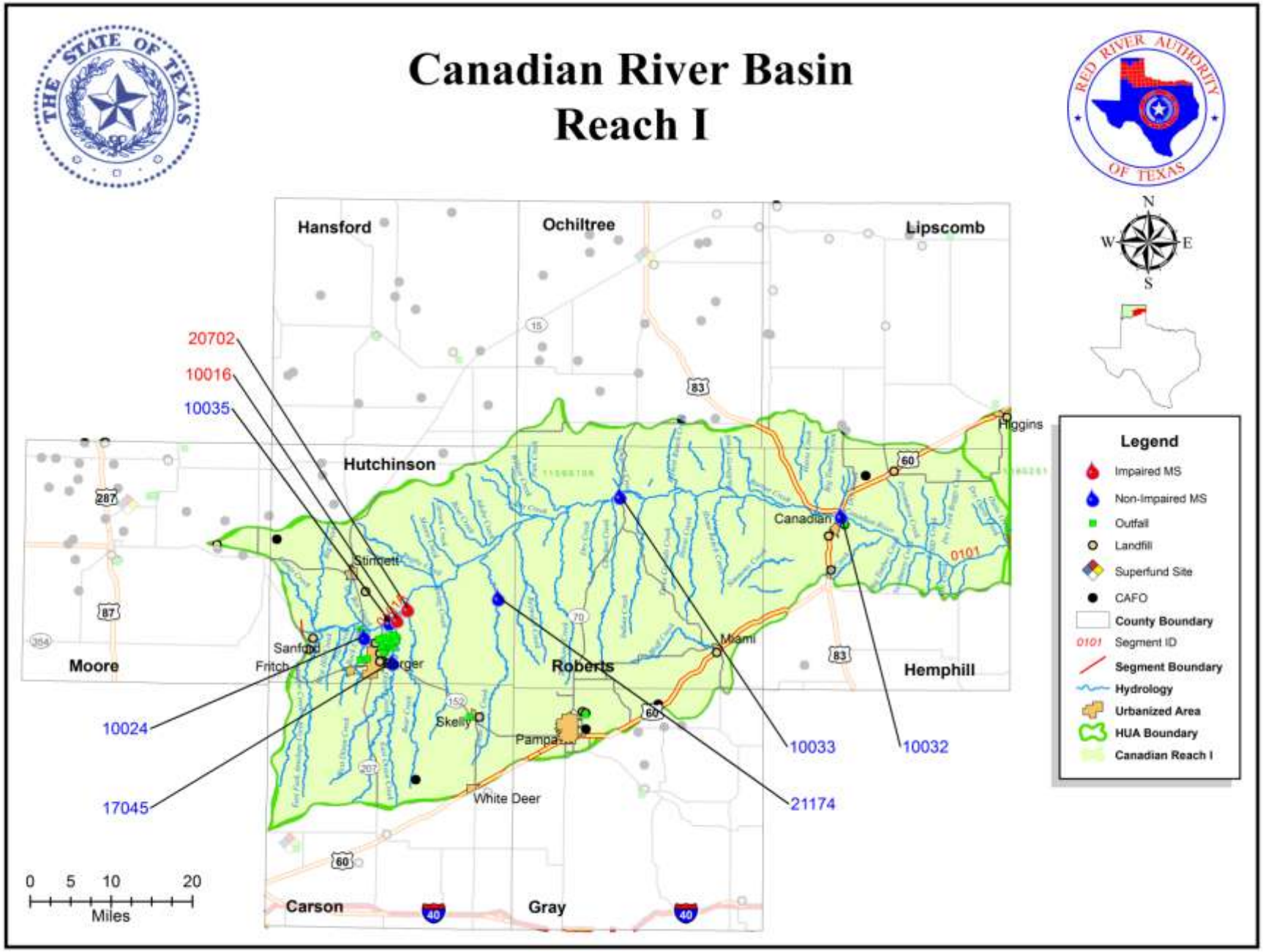
- Increase the number of biological monitoring events throughout the Canadian and Red River Basins to provide TCEQ with enough data to assess during future *IR's*. This data is also essential to aid in the evaluation and development of modernized biotic integrity indexes for both basins;

- Implement biological monitoring in both the Canadian and Red River Basins to help provide a broader view of water quality in the basins. In addition, biological monitoring can be used to determine the level of aquatic life use the system can sustain as well as the associated standards that are appropriate for the system.

- Support the TCEQ's efforts to more accurately document and assess the need for Recreational Use Attainability Analyses by increasing the amount of information documented during routine field monitoring.

Red and Canadian River Basins
Vicinity Map




Canadian River Basin
Reach I
THE STATE OF TEXAS
RED RIVER AUTHORITY OF TEXAS
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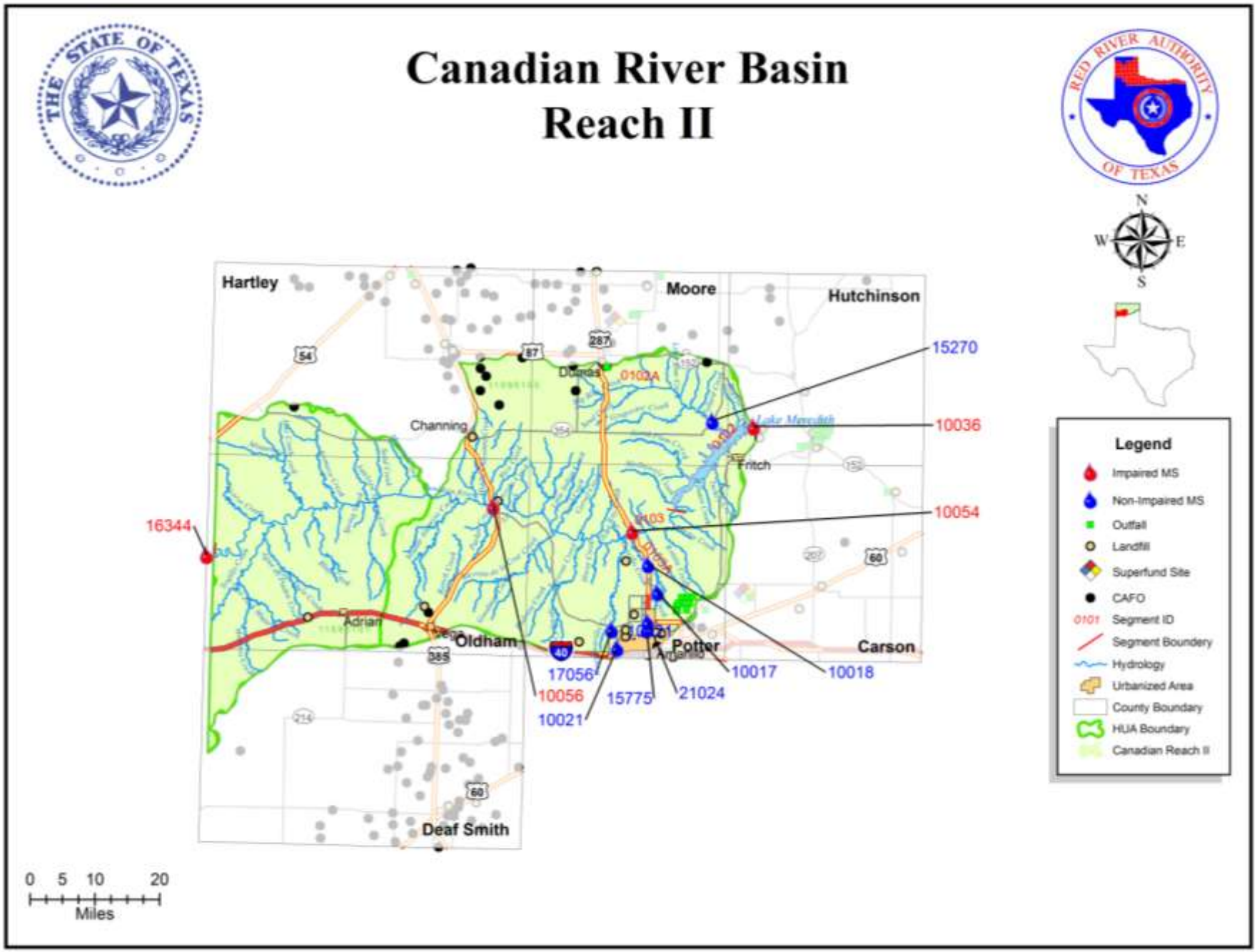
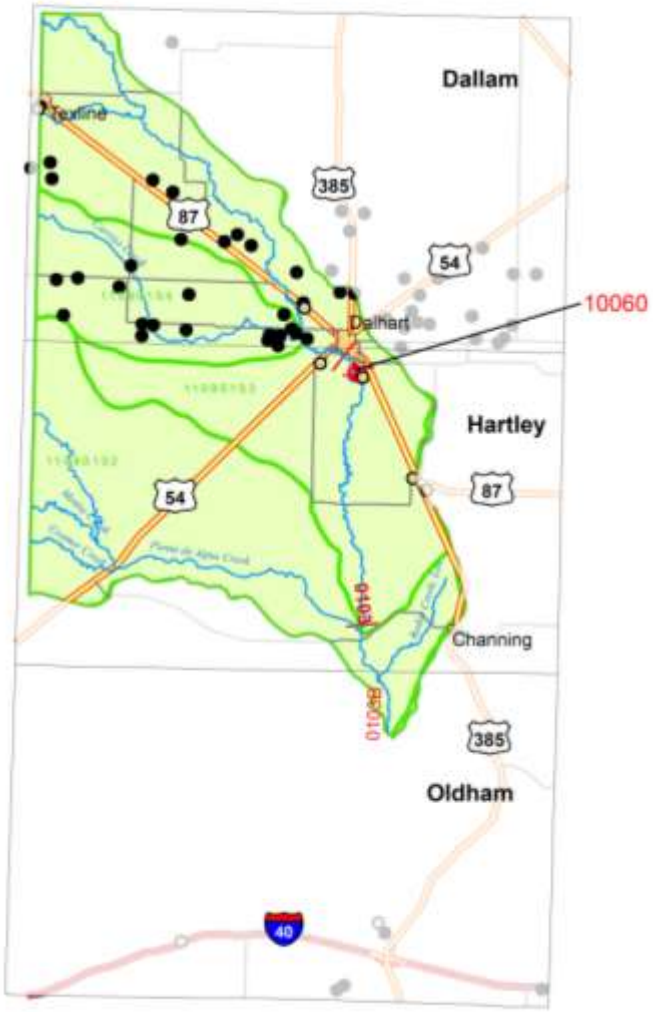
Lipscomb
Hutchinson
Moore
Roberts
Hemphill
Carson
Gray
Sanford
Fritch
Stinnett
Skelly
Pampa
White Deer
Miami
Canadian
Higgins
20702
10016
10035
10024
17045
10033
21174
10032
0101
0 5 10 20
Miles
Legend
Impaired MS
Non-Impaired MS
Outfall
Landfill
Superfund Site
CAFO
County Boundary
Segment ID
Segment Boundary
Hydrology
Urbanized Area
HUA Boundary
Canadian Reach I

Canadian River Basin
Reach II



Canadian River Basin
Reach III

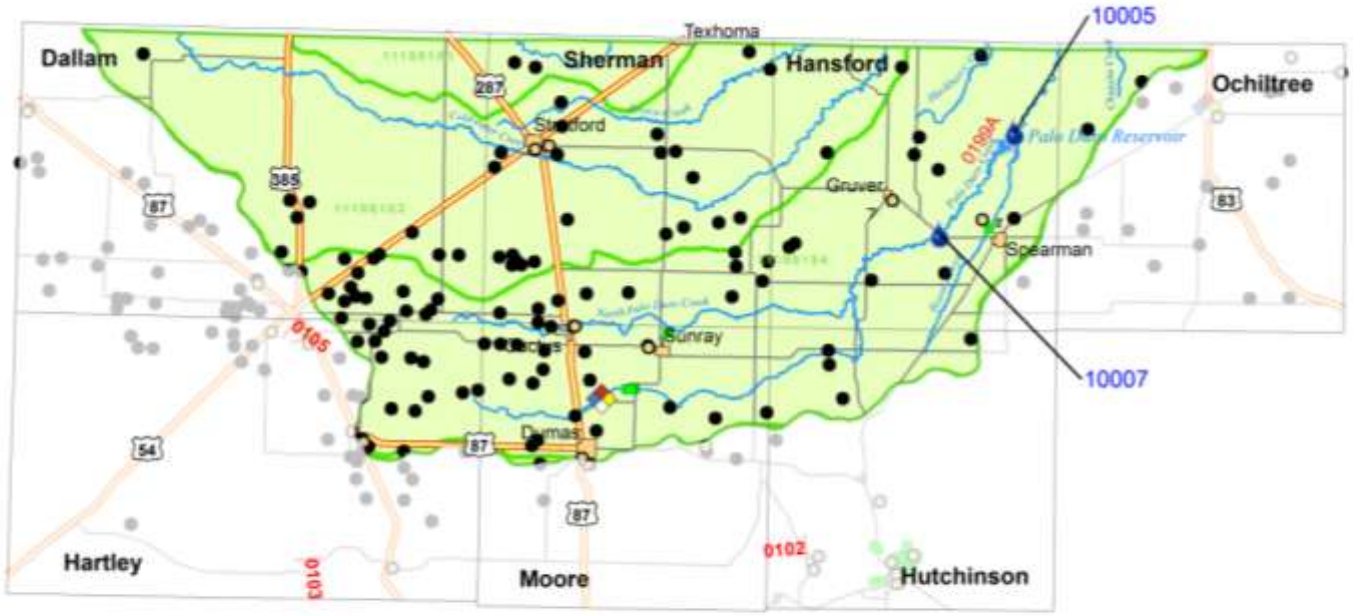


Legend

- Impaired MS
- Non-Impaired MS
- Outfall
- Landfill
- Superfund Site
- CAFO
- 0101 Segment ID
- Segment Boundary
- Hydrology
- Urbanized Area
- County Boundary
- HUA Boundary
- Canadian Reach III

0 5 10 20
Miles

Canadian River Basin
Reach IV



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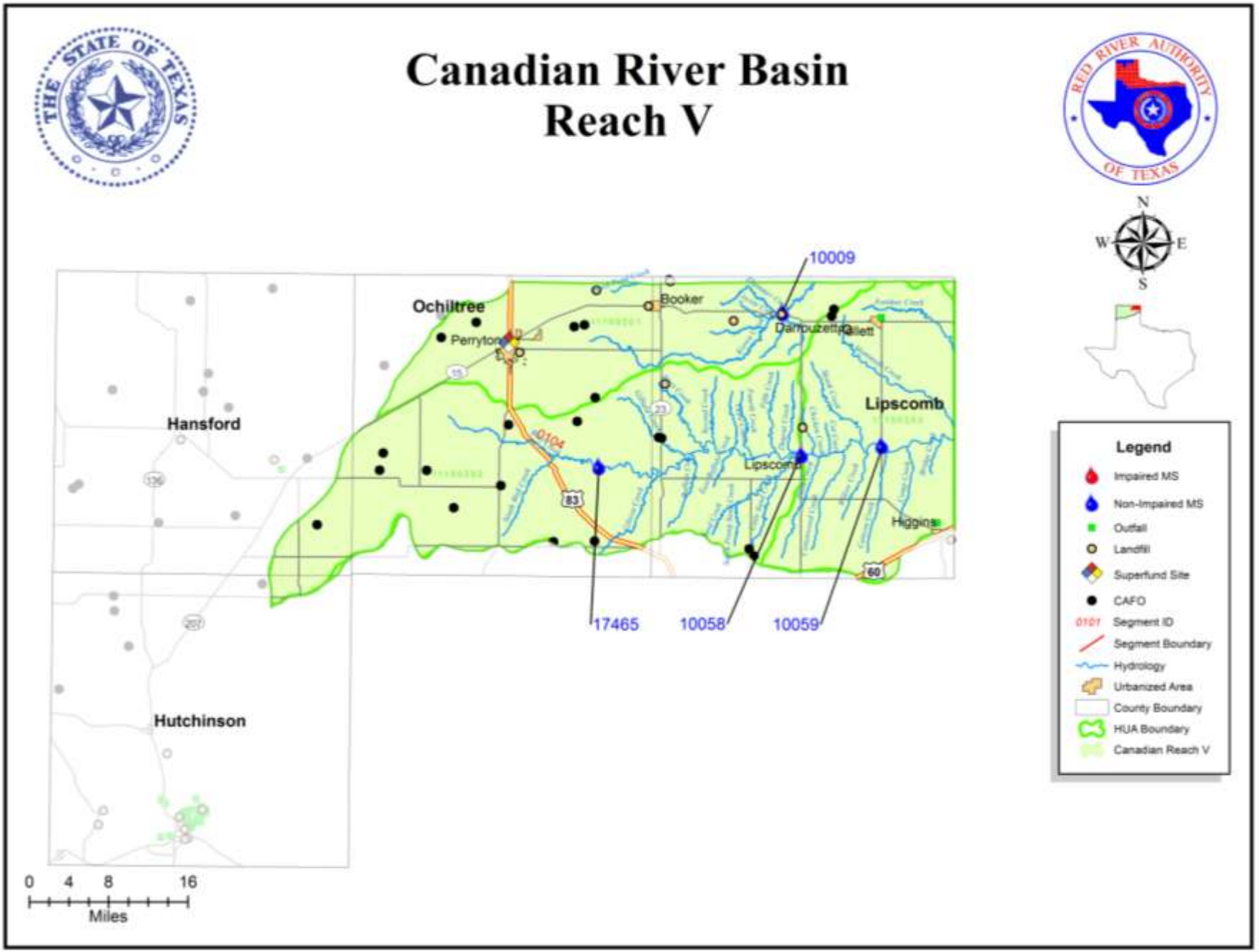
Legend

- Impaired MS
- Non-Impaired MS
- Outfall
- Landfill
- Superfund Site
- CAFO
- 0101 Segment ID
- Segment Boundary
- Hydrology
- Urbanized Area
- County Boundary
- HUA Boundary
- Canadian Reach IV


Canadian River Basin
Reach V
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Booker
Perryton
Hansford
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Higgins
Hutchinson
10009
17465
10058
10059
0104
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Miles
Legend
Impaired MS
Non-Impaired MS
Outfall
Landfill
Superfund Site
CAFO
0101 Segment ID
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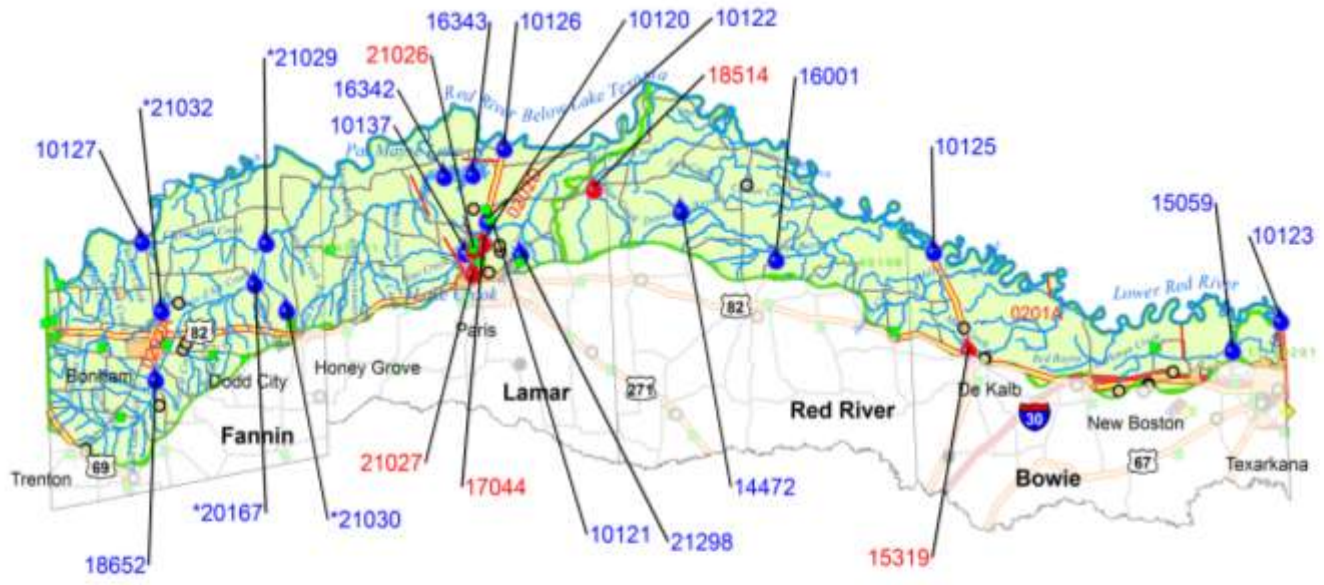
Hydrology
Urbanized Area
County Boundary
HUA Boundary
Canadian Reach V

Red River Basin
Lower Reach I

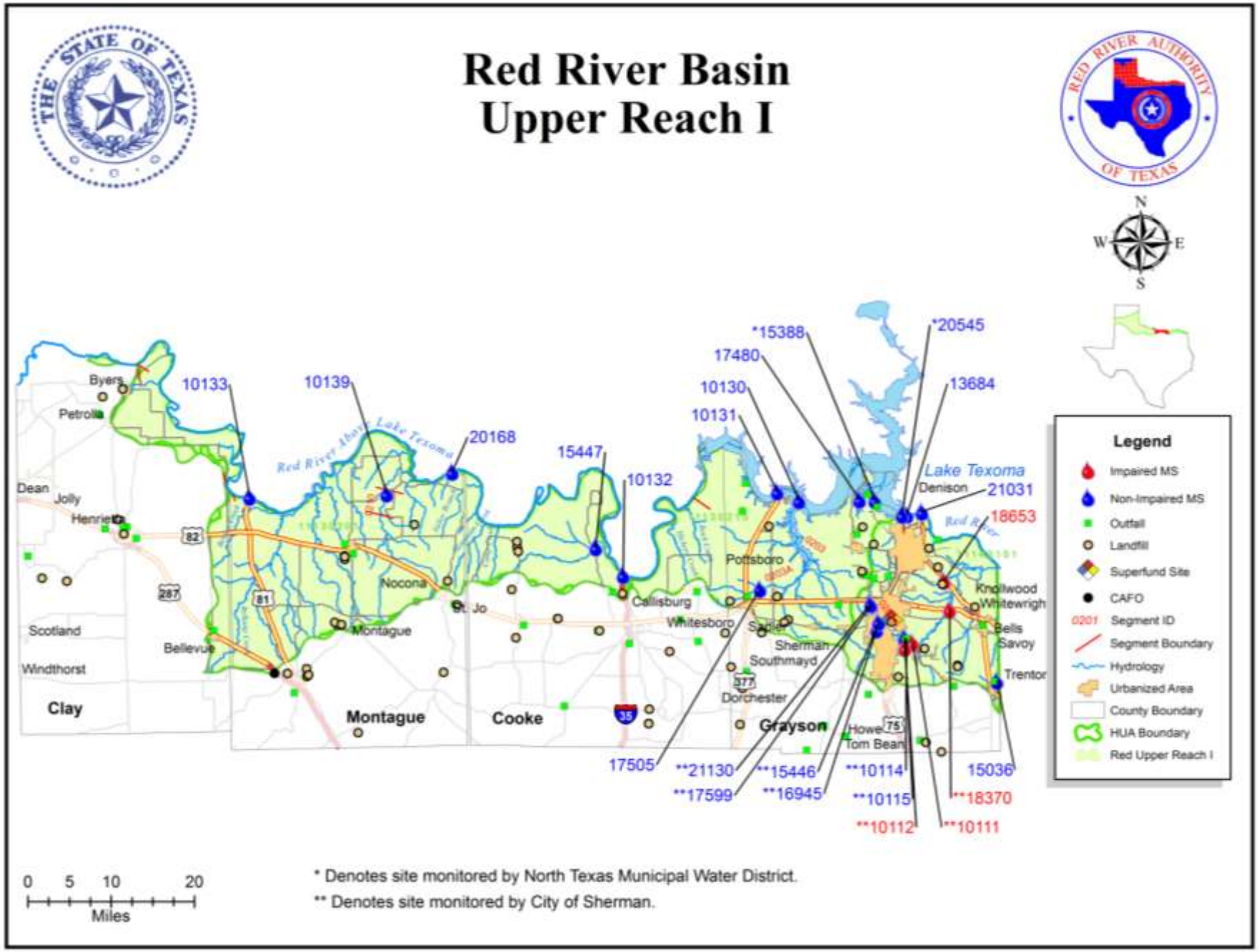


Legend

- Impaired MS
- Non-Impaired MS
- Outfall
- Landfill
- Superfund Site
- CAFO
- 0201 Segment ID
- Segment Boundary
- Hydrology
- Urbanized Area
- County Boundary
- HUA Boundary
- Red Lower Reach I

0 5 10 20
Miles

* Denotes site monitored by North Texas Municipal Water District.


Red River Basin
Upper Reach I
Legend
Impaired MS
Non-Impaired MS
Outfall
Landfill
Superfund Site
CAFO
0201 Segment ID
Segment Boundary
Hydrology
Urbanized Area
County Boundary
HUA Boundary
Red Upper Reach I
Lake Texoma
Red River Above Lake Texoma
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**10111
Byers
Petrolia
Dean
Jolly
Henrietta
Scotland
Windthorst
Bellevue
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Montague
Callisburg
Whitesboro
Pottsboro
Sherman
Denison
Southmayd
Dorchester
Howe
Tom Bean
Knollwood
Whitewright
Bells
Savoy
Trenton
Clay
Montague
Cooke
Grayson
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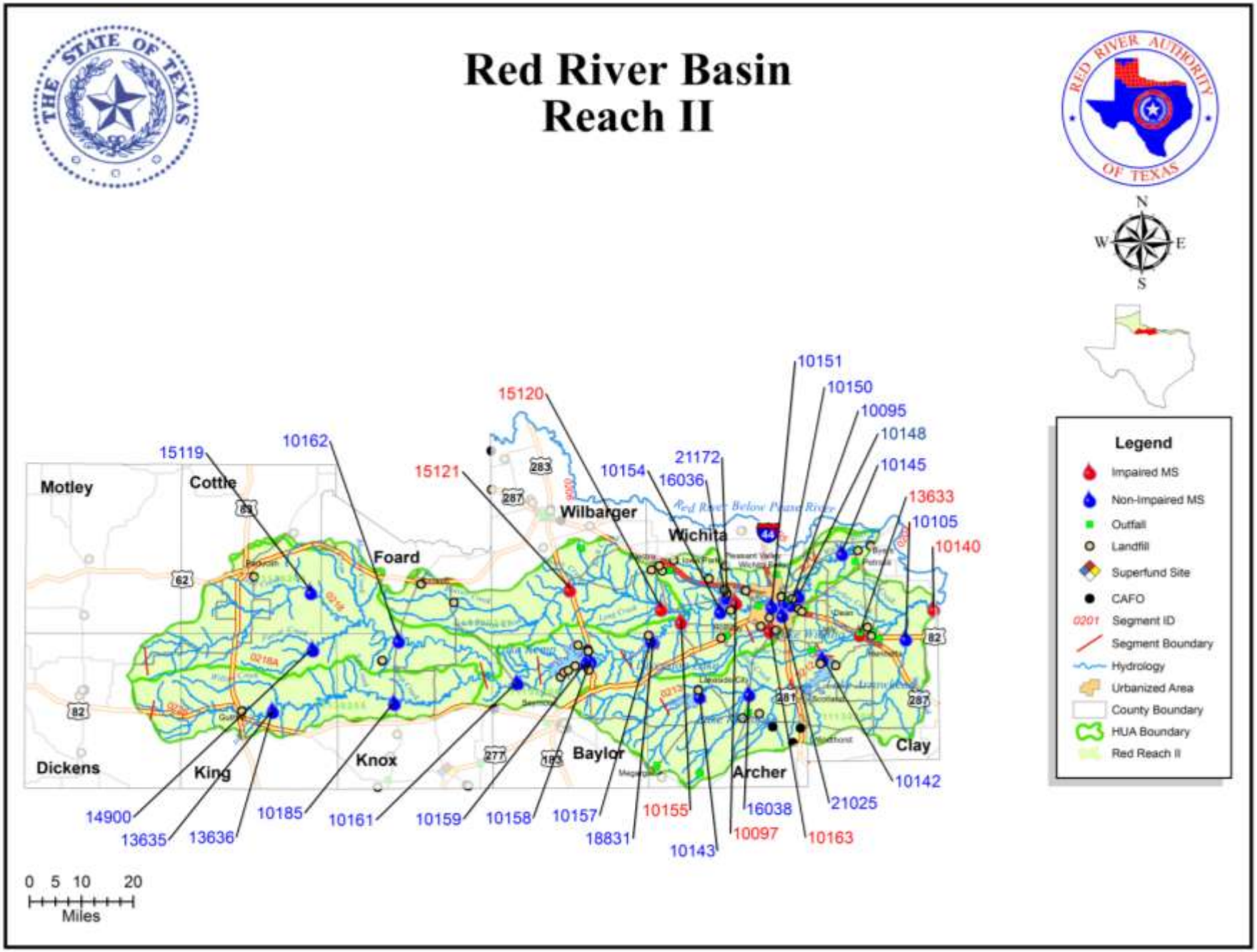
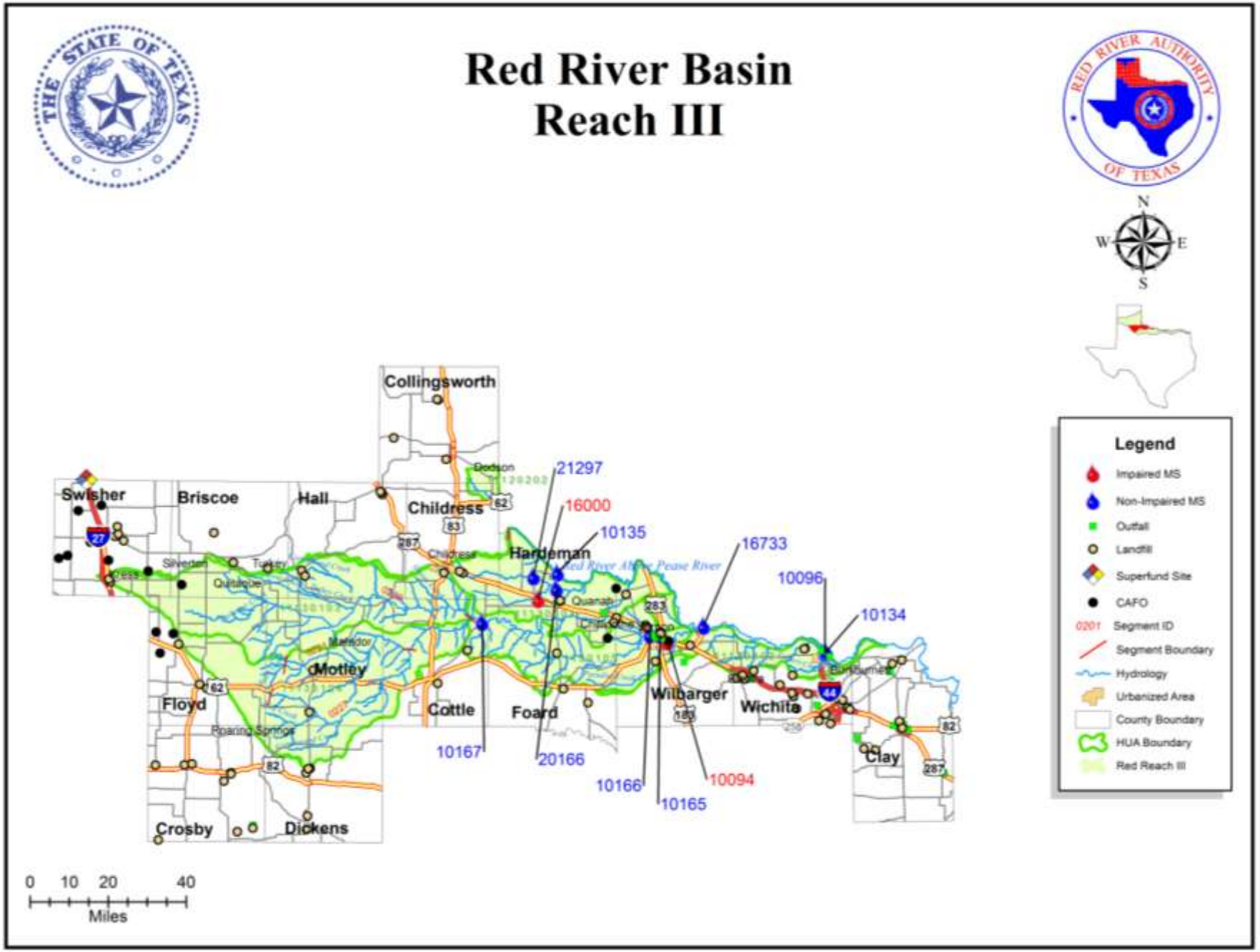
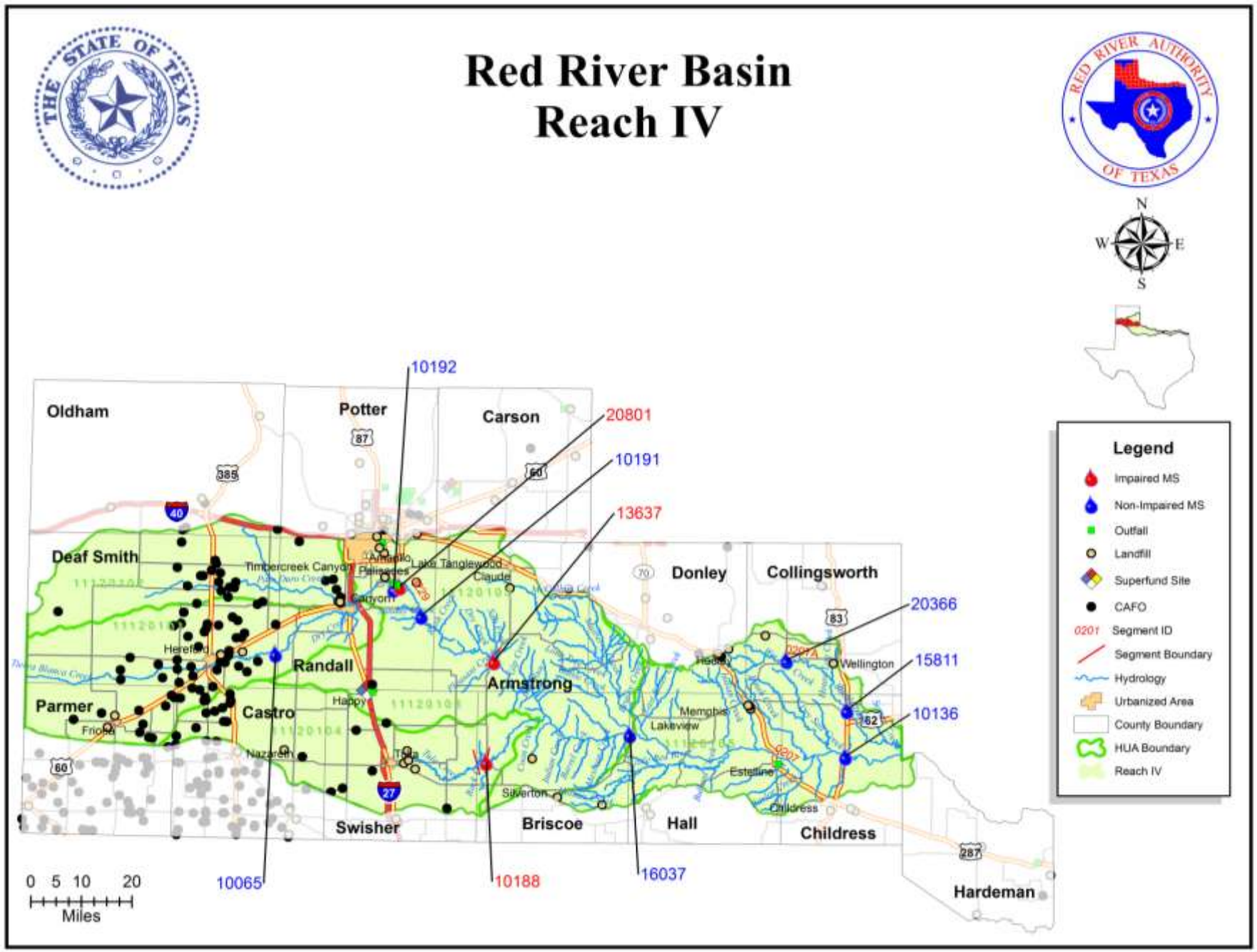
Miles
* Denotes site monitored by North Texas Municipal Water District.
** Denotes site monitored by City of Sherman.

Red River Basin
Reach II



Red River Basin
Reach III




Red River Basin
Reach IV
THE STATE OF TEXAS
RED RIVER AUTHORITY OF TEXAS
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Oldham
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Carson
Deaf Smith
Randall
Armstrong
Donley
Collingsworth
Parmer
Castro
Swisher
Briscoe
Hall
Childress
Hardeman
Timbercreek Canyon
Lake Tanglewood
Claude
Canyon
Hereford
Happy
Friona
Nazareth
Memphis
Lakeview
Estelline
Wellington
Silverton
10192
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13637
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Impaired MS
Non-Impaired MS
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County Boundary
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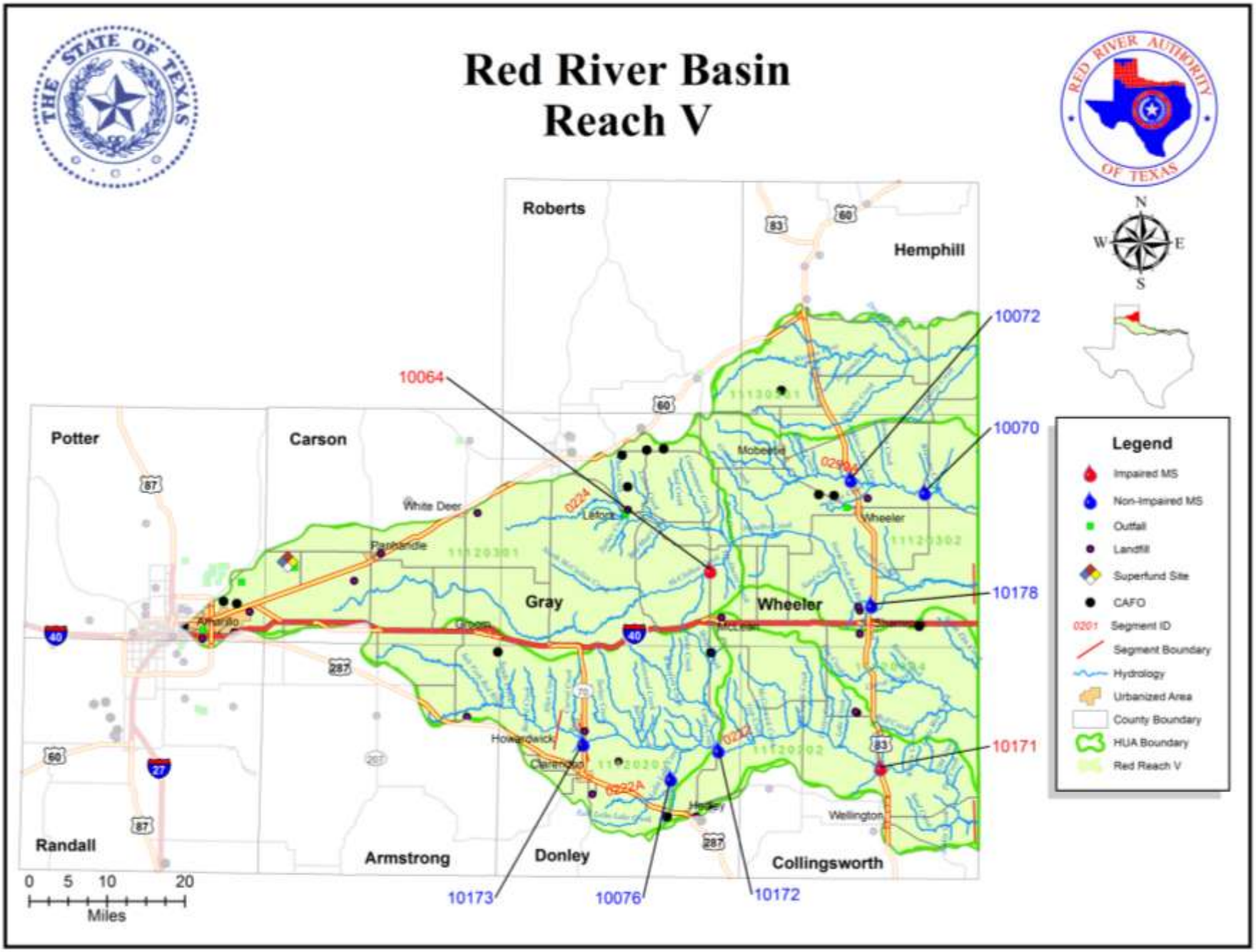
Reach IV


Red River Basin
Reach V
Roberts
Hemphill
Potter
Carson
Gray
Wheeler
Randall
Armstrong
Donley
Collingsworth
Amarillo
White Deer
Pampa
Lefors
Mobeetie
Wheeler
Clarendon
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0201 Segment ID
Segment Boundary
Hydrology
Urbanized Area
County Boundary
HUA Boundary
Red Reach V

North Fork Red River at FM2473

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